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# The Vehicle Logo Location System based on saliency model

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**Abstract.** The intelligent location and recognition of vehicle Logo and vehicle license plate is an important component of intelligent transportation system. In this paper, we mainly study the location of vehicle logo. In the location of the logo, according to the content, it can be divided into coarse location and precise location, coarse positioning is mainly according the position of license plate to locate the region of lamp belt which includes the vehicle logo, which involves the location of license plate. In order to locate the position of vehicle logo accurately, the improved saliency detection method based on the features of the vehicle logo is used. Experimental results show that the model can fast and effectively segment the intensity inhomogeneous images.

**Keywords:** vehicle Logo; coarse location; saliency detection

## 1. Introduction

The intelligent location and recognition of vehicle Logo and vehicle license plate is an important component of intelligent transportation system[1]. The vehicle logo as the main parameters of the vehicle identification has a unique position. In vehicle logo location and recognition system, the accuracy of vehicle logo position affects the recognition result directly, among all of the images processing systems, there are always some problems on the processing effect which are affected by the factors of the image itself, and the vehicle logo image processing has no exception[2]. Compared with the location of the license plate, vehicle logo location has many variable factors, for example, size, shape and position of vehicle logo, these are all not fixed[3].

Vehicle logo location is a part of the design of the vehicle logo recognition system, the logo image location is the same as the other target location, and there are two directions. The first is based on the relationship of position; the second is according to the characteristics of the image. But in view of the particularity of the logo, the two ideas are combined in the graduation design. We can locate the logo by the features of vehicle logo on the base of relationship of position. In this paper, we mainly study the preprocessing of the logo image and the location of vehicle logo. In the part of image preprocessing, the main steps have filter, edge detection and morphological filter. The purpose is to remove the influential elements of target image position. Pretreatment makes the foundation for the later steps of the license plate and the vehicle logo location. In the location of the logo, according to the content, it can be divided into coarse position and precise position, coarse positioning is mainly according the position of license plate to locate the region of lamp belt which includes the vehicle logo, which involves the location of license plate. After coarse position we can get the approximate regional image of the vehicle logo. In order to locate the position of vehicle logo accurately, you need to process the region of the coarse location. Inside of precise positioning contains the filter of the logo background and the prominent of the shape of logo, the background filter need horizontal and vertical differential operation, their difference as direction measurement, the difference is compared with threshold, by this we can recognize the background property, and then use the corresponding edge detection to remove background. Finally we use mathematical morphology method to process image, finally by scanning we can locate logo boundary accurately, then cutting the logo from original image with cutting function.

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## 2. The Proposed Vehicle Logo Location Method

In this paper, we propose a vehicle logo location method which is composed by the coarse location and accurate location.

### 2.1. Coarse location of vehicle-logo region

According to the prior knowledge, vehicle-logos are usually on the top of license plate, and it is with special texture features. It is assumed that a license plate has been located accurately, we can determine rough location of the vehicle logo region according to the following formulae.

$$Y_1 = floor(Y_{\max} - height) = Y_{\min} \tag{1}$$

$$Y_2 = floor(Y_{\min} - t * height) \tag{2}$$

$$X_1 = X_{\min} \tag{3}$$

$$X_2 = X_{\max} \tag{4}$$

where, t=1.5~2.2; $Y_1$ and $Y_2$ are upper and lower boundary coordinates of the vehicle-logo region, respectively; $X_1$ and $X_2$ are left and right boundary coordinates of vehicle-logo region, respectively; $Y_{\max}$ and $Y_{\min}$ are upper and lower boundary coordinates of license plate region, respectively; $X_{\min}$ and $X_{\max}$ are left and right boundary coordinates of license plate region, respectively; Hpai is the height of license plate. The position relation between the vehicle-logo and the license plate is shown in figure 1.The region surrounded by the white rectangular frame is the approximate rage of the vehicle-logo region.

(a)the original image (b)the corresponding coarse location image

Figure. 1 The vehicle logo coarse location image

### 2.2. The Itti's saliency detection model

Input is provided in the form of static color images, usually digitized at 640*480 resolution. Nine spatial scales are created using dyadic Gaussian pyramids [4], which progressively low-pass filter and subsample the input image, yielding horizontal and vertical image-reduction factors ranging from 1:1 (scale zero) to 1:256 (scale eight) in eight octaves.

Each feature is computed by a set of linear "center-surround" operations akin to visual receptive fields: Typical visual neurons are most sensitive in a small region of the visual space (the center), while stimuli presented in a broader, weaker antagonistic region concentric with the center (the surround) inhibit the neuronal response. Such an architecture, sensitive to local spatial discontinuities, is particularly well-suited to detecting locations which stand out from their surround and is a general computational principle in the retina, lateral geniculate nucleus, and primary visual cortex [5]. Center-surround is implemented in the model as the difference between fine and coarse scales: The center is a pixel at scale $c \in \{2,3,4\}$ , and the surround is the corresponding pixel at scale $s = c + \delta, \delta \in \{3,4\}$ . The across-scale difference between two maps, denoted "$\Theta$" below, is obtained by interpolation to the finer scale and point-by-point subtraction. Using several scales not only for c but also for d = s $\Theta$ c yields truly multiscale feature extraction, by including different size ratios between the center and surround regions (contrary to previously used fixed ratios that color map may hurt the object extraction performance compare to other feature maps in case the color of salient object is similar with the background.

However, the luminance map, the color map and the orientation map are not all effective for the output saliency map. For instance, in general, color map is known as a major feature to distinguish salient and non-salient object. However, in this paper, we prove that the color map is not always good feature for extraction of the salient object. Especially, incase the salient object has protective coloration, color map rather hurt the extraction performance.

## 2.3. Accurate location of vehicle-logo region

In this section, we will improve Itti's saliency detection algorithm. The contrast map is created by six luminance maps, twelve color maps and eighteen orientation maps.

Before creating the luminance map, we apply the gaussian filter to the image in order to remove noises. Then, we apply the different size of filters to the down-sampled image. The filter estimates difference between a "center-point" and surrounded-points of image scale c and filter scale s. In Equation (5), G(c,s) is the intensity difference between a center point and surrounded points. In this method, the feature map is sensitive to the size of contrast-filters. If the size of an object is bigger than the filter size, saliency of luminance map has low contrast value and if it has smaller than the filter size, saliency of luminance map has high contrast value. To overcome this defect, we reduce the image size by a factor of 2, 3 and 4. The filters are also adjusted by the factor of the image size like Equation (5). By using the Equation (5), we can make six feature maps. To combine the different size of feature maps with one image, we normalize them to one quarter of the original image size. In Equation (5), D( $\cdot$ ) is the combined feature map at scale of c. Six maps are all summed and normalized into luminance map.

$$\overline{L} = \frac{1}{6}\sum_{c=2}^{4} D(\sum_{S=c+3}^{c+4} G(c,s)) \tag{5}$$

In order to get color map, we use the CIE L*a*b* color model because it is a device independent and it is similar to human color perception. Here, we use the a* and b* color model except the L*(luminance of L*a*b). The process of color map is similar to the process of luminance map. As the same method with the luminance map, we use the different size of filters and images. We create six feature maps from each a* and b* color model and normalize them as one color feature map. Before creating color feature map, we also apply the gaussian filter to the image. In Equation (6), A(c, s) and B(c, s) is the color difference between a center point and surround points at image size c and filter size s.

$$\overline{C} = \frac{1}{12}(\sum_{c=2}^{4} D(\sum_{S=c+3}^{c+4} A(c,s)) + \sum_{c=2}^{4} D(\sum_{S=c+3}^{c+4} B(c,s)) \tag{6}$$

Color is based on the observation often is used to encode functionality (sky is blue, forests are green) and in general will not allow us to determine an object's identity [8]. Therefore, texture or geometric properties are needed to identify objects.

Since salient regions have special texture information, we use the wavelet transform in order to get texture information at different scales. After the one level wavelet transform, we get the horizontal (HL), vertical (LH) and diagonal (HH) orientation information from the wavelet subbands. Then, we create the orientation map as the same method with luminance and color map. In Equation (7), O(c, s)is the coefficient difference between a center coefficient and surrounded coefficients at image size c and filter scale s. From Equation (7), We can get the eighteen feature maps and these are normalized into one orientation map. Fig. 2 shows the corresponding vehicle logo accurate location image.

$$\overline{O} = \frac{1}{18}(\sum_{HH,HL,LH} (\sum_{c=2}^{4} D(\sum_{S=c+3}^{c+4} O(c,s))) \tag{7}$$

Figure. 2 The vehicle logo accurate location image

## 3. Experimental results

The experiments are implemented with Matlab code run on a Dell Dimension 4600 PC, with Pentium 4 processor, 2.80 GHz, 1 GB RAM, with Matlab 7.0 on Windows XP.

To evaluate the proposed method, we have done a large number of experiments. Among 303 vehicle images, the vehicle-logo location rate is 97%. A part of experimental results are shown in figure 3 to figure 6. The experimental results show that the proposed method locating vehicle-logos is very effective. It is fit for not only vehicle-logos with horizontal and vertical textures, but also vehicle-logos with small meshy textures.

(a) The original image (b) Final result

Figure 3 The location of the vehicle-logo with meshy texture

(a) The original image (b) Final result

Figure 4 The location of the vehicle-logo with meshy texture

(a) The original image (b) Final result

Figure 5 The location of the vehicle-logo with meshy texture

(a) The original image (b) Final result

Figure 6 The location of the vehicle-logo with meshy texture

## 4. Conclusion

This paper presents a novel approach for vehicle-logo location based on vehicle license plate plate and saliency detection. We find out the approximate scope of vehicle-logo according to the position relation between the vehicle-logo and the license plate. And then we accurately extract the vehicle-logo by saliency detection.

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