



An Improved Method of License Plate Localization under Complex Background

Yingzhen Wu
2819****
SEU-Monash JGS
25/5/2017

KEYWORDS

License Plate Localization, [complex background](#),
color detection, morphology, wavelet transform

CONTENT

1. Objectives
2. Methodology
3. Novelty
4. Conclusion
5. References

Preprocessing



Rough localization

- Color Detection
- Morphological Operations

Accurate localization

- Edge Detection
- Wavelet Transform



OBJECTIVES

Proposed issues
Goal of research

PROPOSED ISSUES

◆ Limitations

Color detection

require that the background cannot have a similar color to the plate

Morphology

time-consuming

Edge Detection

make no sense unless it combines with other methods

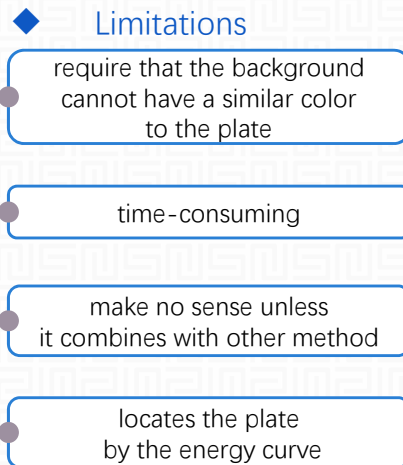
Wavelet transform

locates the plate by the energy curve



Figure. Captured image of a motor vehicle in the complex background

OBJECTIVES



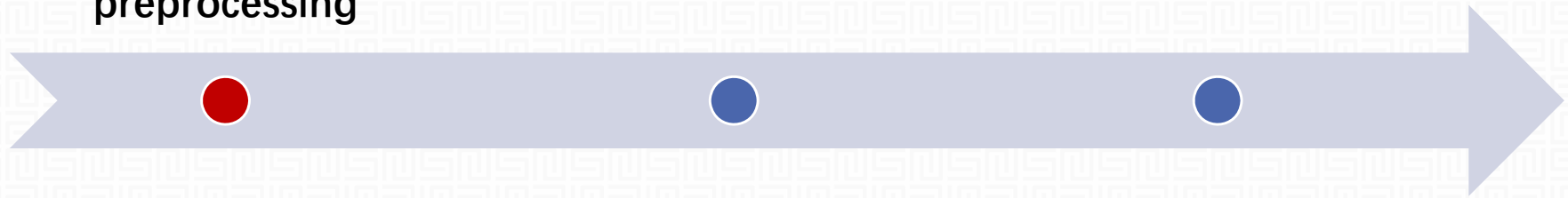
◆ An Improved Method of License Plate Localization under Complex Background



METHODOLOGY

Three-Phase Gradual
Localization

preprocessing



PREPROCESSING

Preprocessing

1. normalization
a standard input in the form of 400*300 pixels
2. Enhancement
improve brightness and contrast

$$g(i, j) = \alpha f(i, j) + \beta \quad \text{where } \alpha = 1.5$$

$$\beta = \frac{\sum_{c=1}^3 \sum_{i=1}^{300} \sum_{j=1}^{400} f_c(i, j)}{3 * 300 * 400}$$

◆ symbol description

- c - Channels of RGB image
- $f(i, j)$ - input image
- $g(i, j)$ - enhanced image
- α - an empirical value.
- β - changed related to the average lightness of the input.
If the image is dark (light), this value will be high (low).

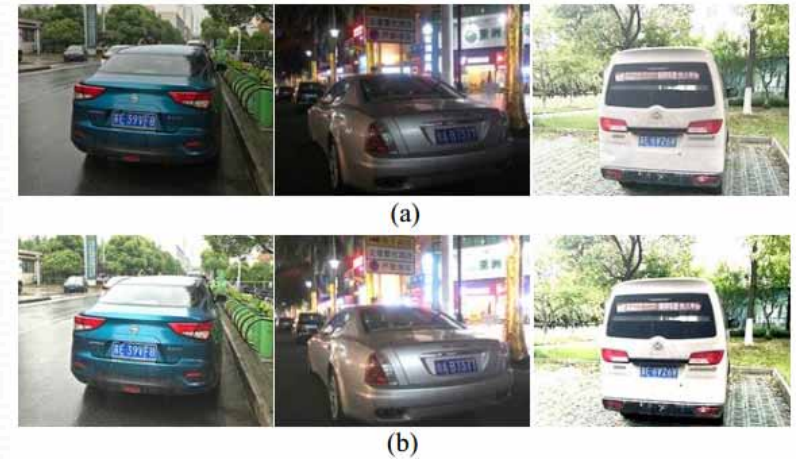


Figure 1. image capture and enhancement:
(a) standard image and (b) enhanced image.

Rough localization



COLOR DETECTION

Rough localization



Referenced from: *License plate of motor vehicle of the People's Republic of China*

Table 1. the value range of four colors of the license plates in HSL space

| | Blue | Yellow | White | Black |
|---|------------|-----------|------------|----------|
| H | [100, 124] | [26, 34] | [0, 180] | [0, 180] |
| S | [43, 255] | [43, 255] | [0, 30] | [0, 255] |
| L | [46, 255] | [46, 255] | [221, 255] | [0, 46] |

$$m(x, y) = \begin{cases} 1 & 100 < h(x, y) < 124, 43 < s(x, y) < 255, 46 < l(x, y) < 255 \\ 0 & \text{else} \end{cases}$$



(a)



(b)



(c)

Figure 2. color detection process:

(a) enhanced image, (b) HSL image and (c) blue region marked image

◆ symbol description

$h(x, y)$ - Hue

$s(x, y)$ - Saturation

$l(x, y)$ - Lightness

$m(x, y)$ - Output pixel

MORPHOLOGICAL OPERATIONS

Rough localization

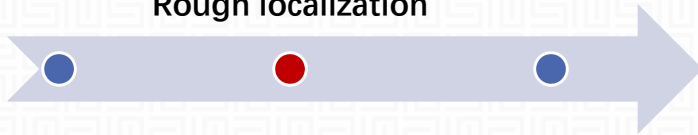


Figure 4. Example output of the rough localization

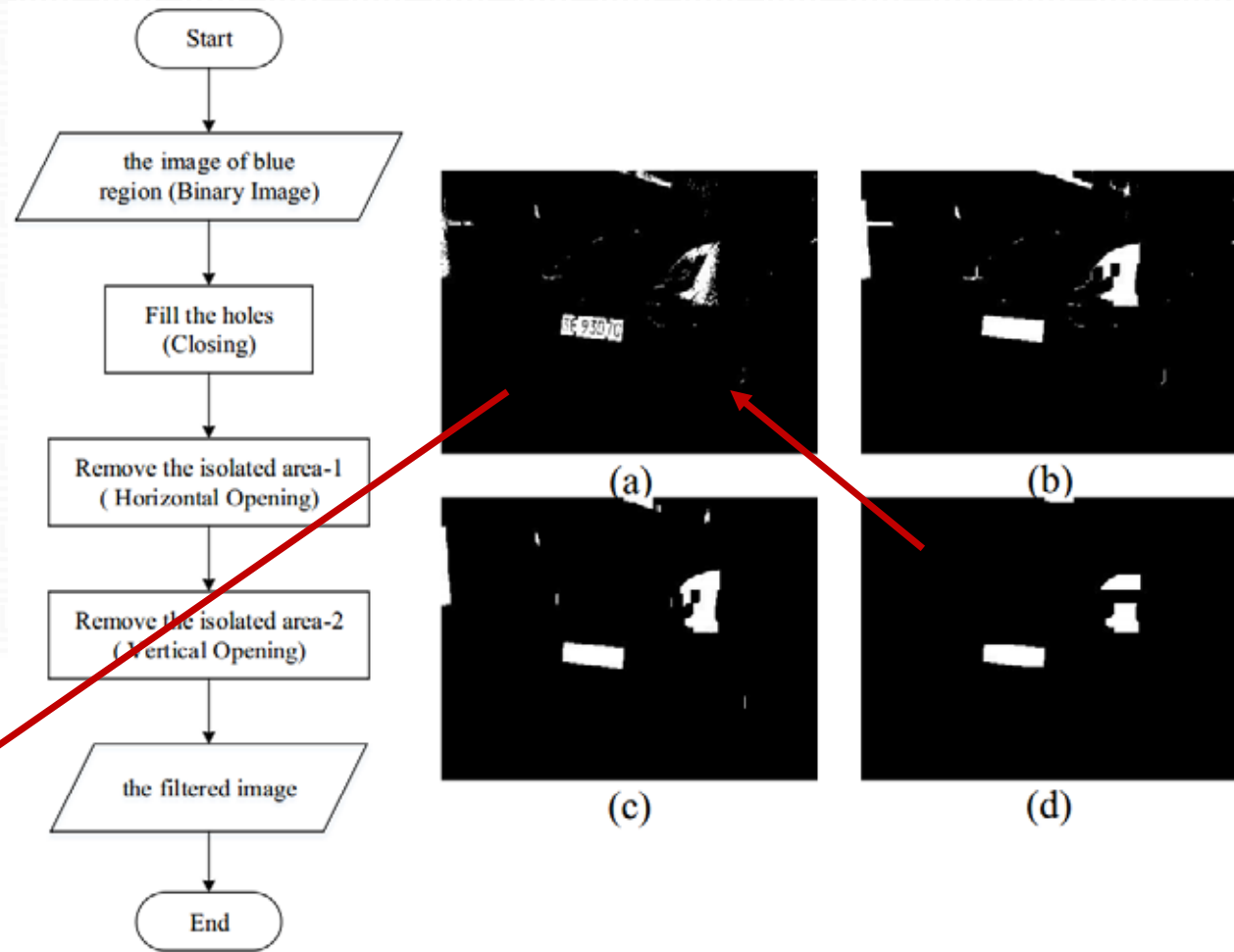


Figure 3. Morphological progress:
(a) input image, (b) image filled holes,
images after (c) horizontal opening and (d) vertical opening

Accurate localization

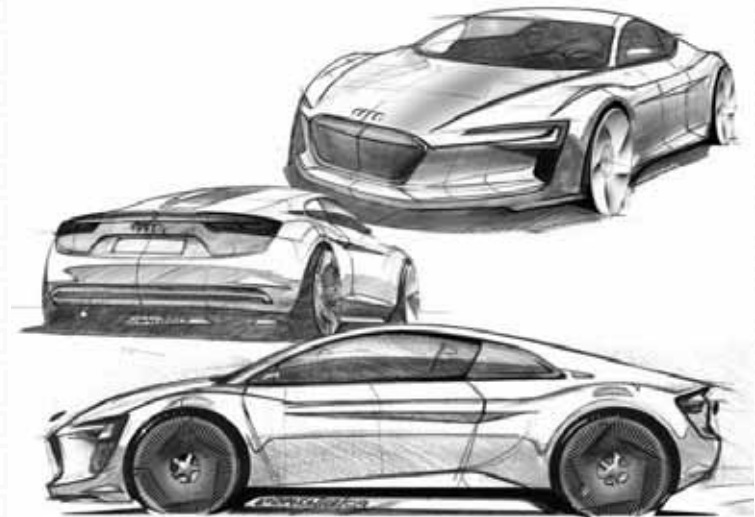
- Selection of method



EDGE DETECTION

Sobel operator

$$Sobel_h = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}, \quad Sobel_v = \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$$



Referenced from: Audi e-tron Concept Design Sketch
<http://www.carbodydesign.com>



(a)



(b)

Figure 5. Edge detection comparison: (a) horizontal edge and (b) vertical edge

WAVELET TRANSFORM - 1

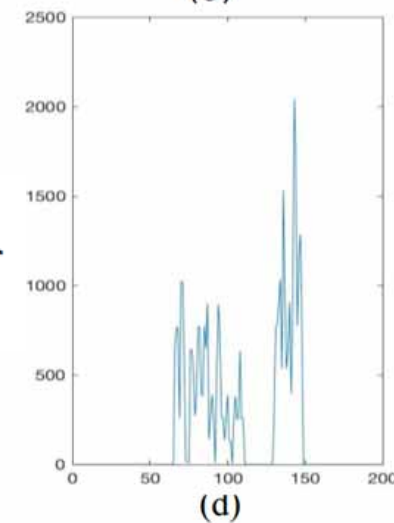
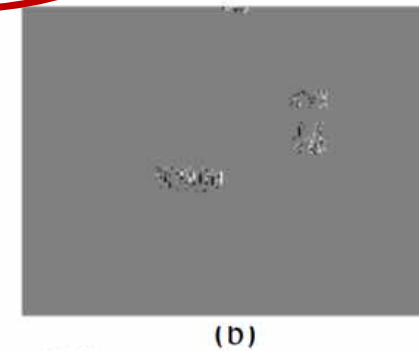
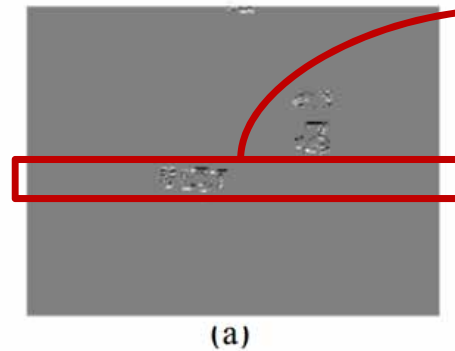
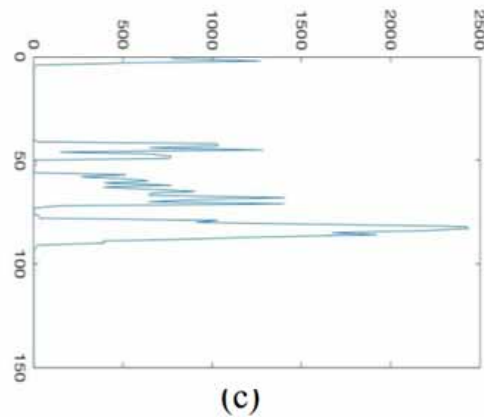
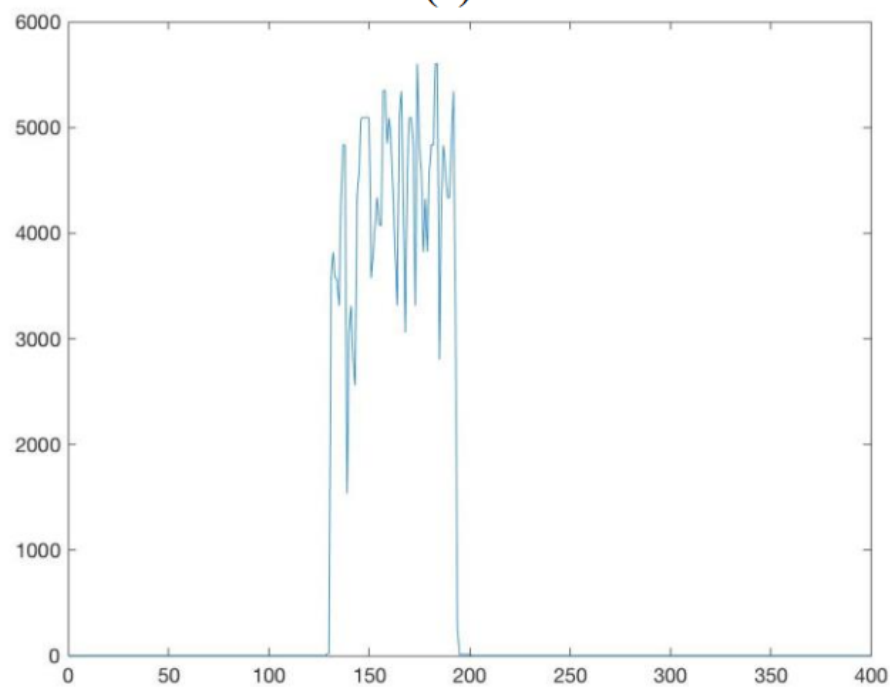


Figure 6. Horizontal (a) and vertical (b) frequency band of wavelet transform, Horizontal and vertical frequency energy curves: summing up pixel intensities of (c) each row in horizontal band and (d) each column in vertical band

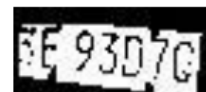
WAVELET TRANSFORM - 2



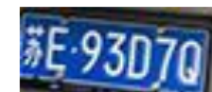
(a)



(b)



(a)



(b)

Figure 8. Plate Localization: (a) binary and (b) color form



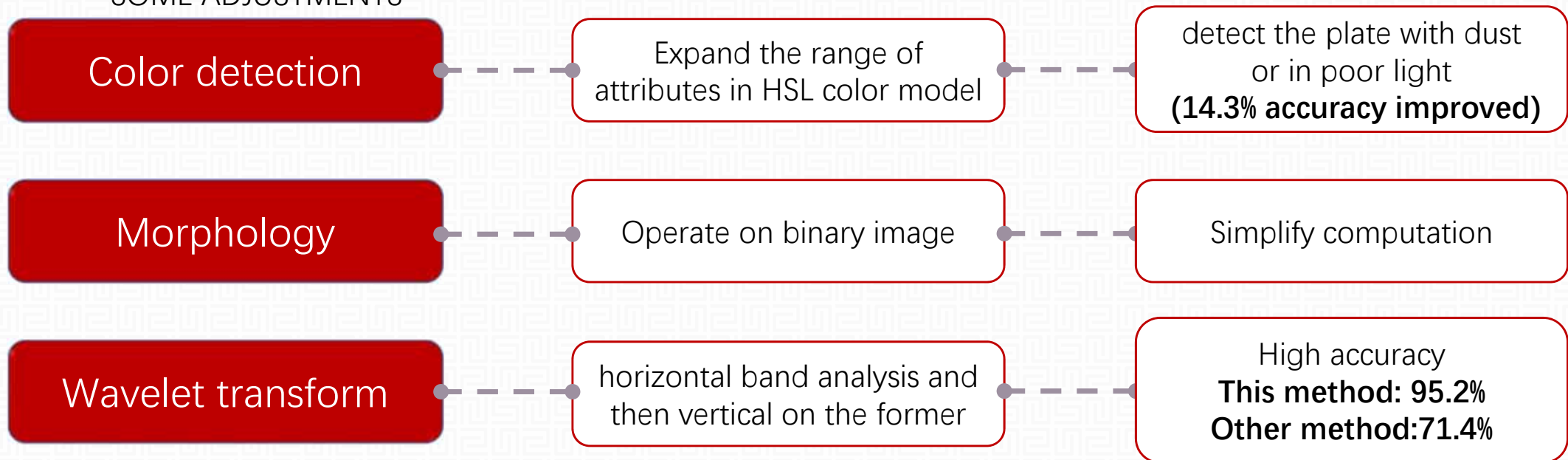
NOVELTY

Three-Phase Gradual
Localization

NOVELTY

- ◆ Differ from previous related research, my research can solve the LPL even in the **complex background**.

SOME ADJUSTMENTS





CONCLUSION

Three-Phase Gradual
Localization

CONCLUSION

Preprocessing

Accurate localization

- Edge Detection
- **Wavelet Transform**

Rough localization

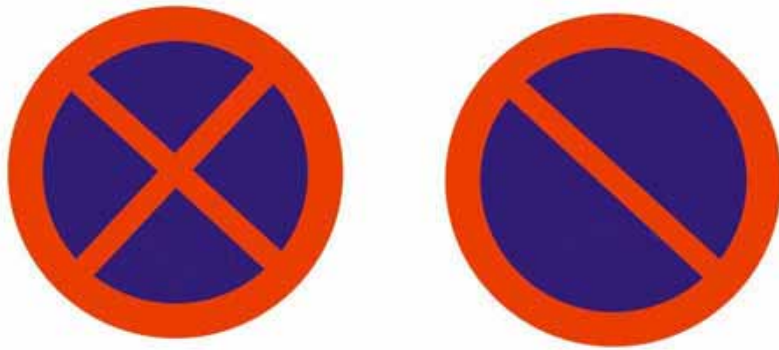
- Color Detection
- Morphological Operation

SIGNIFICANCE

The traffic management department prohibits cars from parking along the roads with large traffic.

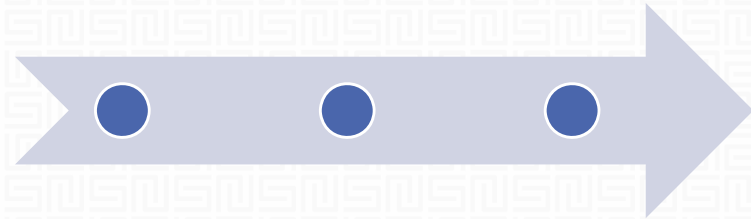
The layout of streets with large traffic is so complex that can consider as a complex background.

still handled manually



Cars are not allowed to be parked temporarily or for long periods

Referenced from: *Signs of traffic signs in China*



◆ further realize the intelligence and digitization of traffic management

REFERENCES

Cheng, Z., & Chen, R. (2009). License plate location method based on modified HSI model of color image. *IEEE International Conference on Electronic Measurement & Instruments*, 4, 197-201.

Davis, A. M., Arunvinodh, C., & Arathy Menon, N. P. (2015). Automatic license plate detection using vertical edge detection method. *International Conference on Innovations in Information, embedded and Communication Systems*, 1-6.

Faradji, F., Rezaie, A. H., & Ziaratban, M. (2007). A Morphological-Based License Plate Localization. *IEEE International Conference on Image Processing*, 1, 57-60.

Han, H., & Han, R. (2012). Method of license plate localization based on edge detection and color information. *IEEE International Conference on Transportation, Mechanical, and Electrical Engineering*, 1477-1480.

Rajput, H., Som, T., & Kar, S. (2015). An automated vehicle license plate recognition system. *Computer*, 48(8), 56-61.

Wen, W., Huang, X., Yang, L., Yang, Z., & Zhang, P. (2009). Vehicle License Plate Location Method Based-on Wavelet Transform. *IEEE International Joint Conference on Computational Sciences and Optimization*, 2, 381-384.

| THANK YOU

Q & A