Indonesian Journal of Electrical Engineering and Computer Science
Vol. 1, No. 1, January 2016, pp. 215 ~ 220
DOI: 10.11591/ijeecs.v1.i1.pp215-220

One Layer Object Separation Algorithm in Binary Image

Ratri Dwi Atmaja*, Erwin Susanto, Junartho Halomoan, Muhammad Ary Murti
School of Electrical Engineering, Telkom University
Jalan Telekomunikasi no.1, Terusan Buah Batu, Bandung 40257, Indonesia
*Corresponding author, e-mail: ratridwiatmaja@telkomuniversity.ac.id

Abstract

We propose an algorithm to separate black object in binary image. The algorithm is designed to perform vertical separation first, then followed with horizontal separation. This process is done only once (one layer). Results showed that the algorithm potentially could be developed into n-layer separation in a recursive function. The algorithm also potentially could be developed in adaptive to determine when to use a vertical or horizontal separation first. It could be expected to reduce the recursive number.

Keywords*: one layer, object separation, algorithm, binary image*

1. Introduction

There are 3 subsystems in video intelligent traffic control system, which are vehicle-detecting subsystem, vehicle-counting subsystem and timecontrolling subsystem [1]. As proposed on [1], it provided an improved algorithm for vehicle flow monitoring based on Daubechies wavelet and the experiment proved its higher accuracy than the algorithm without wavelet processing, especially under bad weather. The other research, moving vehicle detection and tracking algorithm in traffic have also presented [2, 4, 5]. It can produce the desired segmented image in binary [2] and can count the number of vehicle which passed [4]. These four articles are included into vehicle-detecting and vehicle-counting subsystem.

The one which also helpful in video intelligent traffic control system is vehicle recognition. It is very important for the traffic monitoring and regulation of highway, tunnel, highway, as well as the large parking management [3]. The research on [3] have designed geometric parameters, such as length, width, contour area, minimum bounding rectangle area, length-width ratio and space occupancy. It has also combined parameters for vehicle classification, finally sets up a vehicle classifier based on these characteristics parameters. However, it didn't explain how to separate every vehicle before doing classification. Many vehicles pass in the highway and object separation is needed before doing classification.

This paper proposes an algorithm to separate black object in binary image. The algorithm only focuses to the separation process. This can conduct the output of segmented image in binary [2] before using classification method on [3]. This also can be used to count the number of vehicle if it has a good performance.

2. Research Method

Figure 1 is the flowchart of proposed algorithm and Figure 2 is the vertical and horizontal separation algorithm. In Figure 2(a), *A* is 1-dimensional matrix obtained by summing array elements of binary image vertically. *MaxA* is the largest value of *A*. *B* is 1-dimensional matrix represents the left border of each object, while *C* is 1-dimensional matrix represents the right border of each object. *B* has the same length as *C*. *Length1* in figure 1 is the length of *B* or *C*. In Figure 2(b), *image* is a binary image obtained from separation result vertically. *D* is 1-dimensional matrix obtained by summing array elements of *image* horizontally. *MaxD* is the largest value of *D*. *E* is 1-dimensional matrix represents the up border of each object, while *F* is 1-dimensional matrix represents low border of each object. *E* has the same length as *F*. *Length2* in figure 1 is the length of *E* or *F*.

Received September 25, 2015; Revised December 4, 2015; Accepted December 22, 2015

The step in Figure 2(a), *column* is the column number of binary image result from converting to binary, *template* obtained by placing *maxA* at the beginning and the end of *A*, then *max* is taken from *maxA*. While the step in Figure 2(b), *column* is the row number of *image*, *template* obtained by placing *maxD* at the beginning and the end of *D*, then *max* is taken from *maxD*.

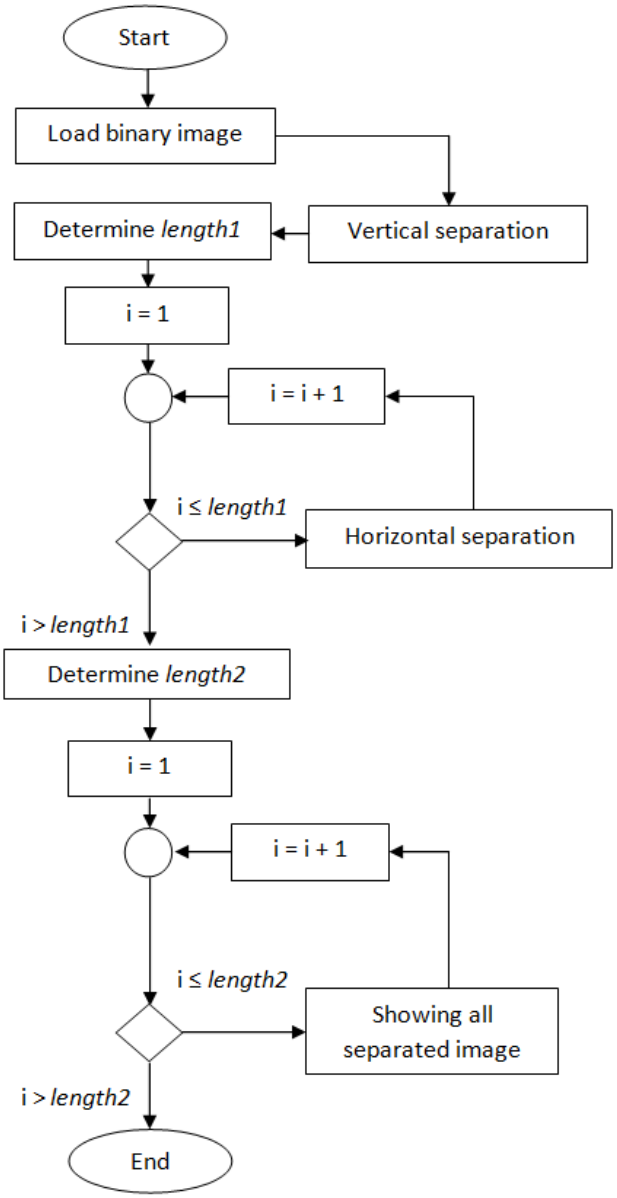


Figure 1. The flowchart of proposed algorithm

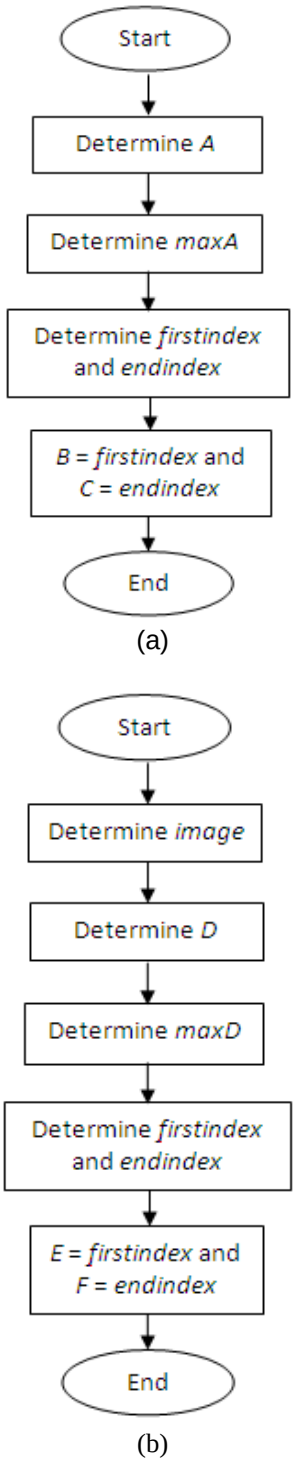


Figure 2. (a) Vertical separation algorithm and (b) Horizontal separation algorithm

The algorithm to find *firstindex* and *endindex* can be found in Figure 3.

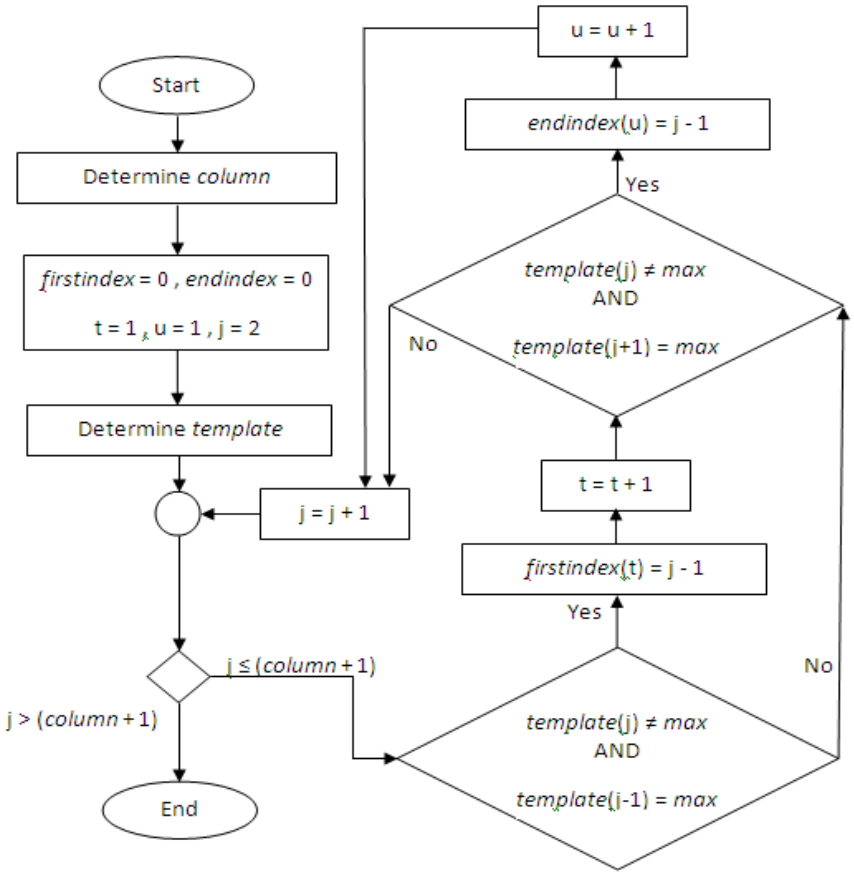


Figure 3. Flowchart to find *firstindex* and *endindex*

Figure 4 is example of a binary image and the output of processes

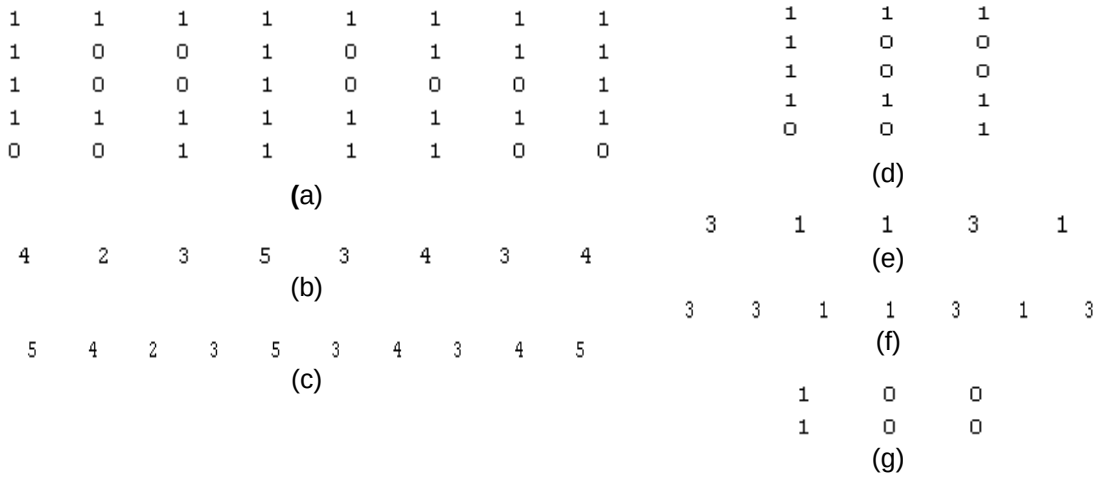
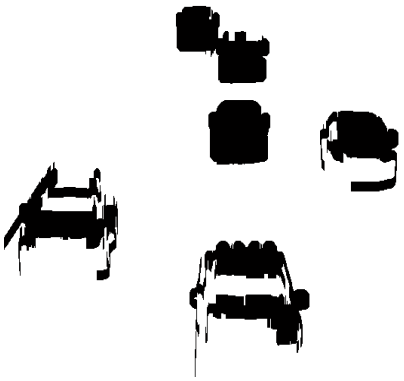
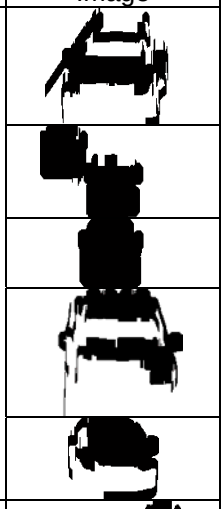
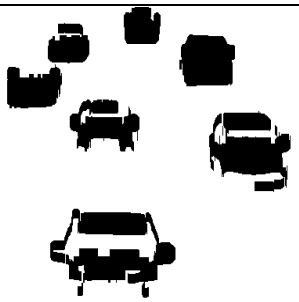
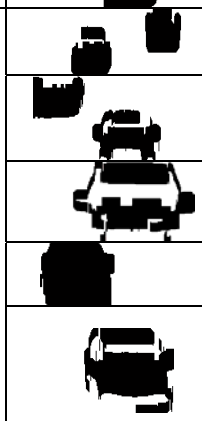
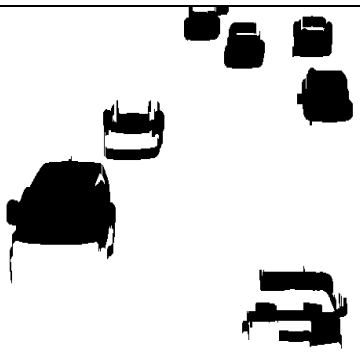
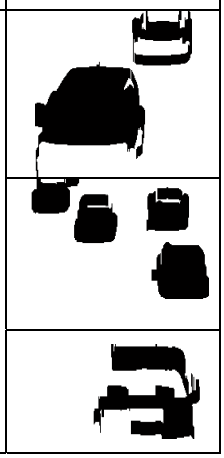


Figure 4. Example of binary image taken (b) The matrix of *A* (c) The *template* of vertical separation process (d) The first *image* (e) The matrix of *D* (f) The *template* of horizontal separation process and (g) the first separated image

3. Results and Analysis

Table 1 is the result of separation.

Table 1. The result of separation

No	Grayscale Image	Binary Image	Separated Image
1			
2			
3			

One layer separation is not necessarily produces a separated image as much as the number of objects. The second grayscale image needs two layers separation until generating 7 separated images. The third grayscale image also needs two layers separation to get the best result. This separation algorithm still has weaknesses in 2 ways:

a. The algorithm is designed with vertical separation first, then followed with horizontal separation (not adaptive). The example can be seen in the first binary image at Table 2.
b. The algorithm has not been able to separate some objects that can not be separated either vertically or horizontally. The example can be seen in the second binary image at Table 2.

Table 2. Example of separation result to understand the weaknesses of the algorithm

No	Example of Binary Image Taken	Separated Image
1	1 1 1 1 1 1 1 1 0 0 0 0 0 1 1 0 0 0 0 0 1 1 1 1 1 1 1 1 1 0 0 1 1 1 1 1 0 0 1 0 0 1 1 1 1 1 0 0 1	0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 0 0 1 0 0 1 1 1 0 0
2	1 1 1 1 1 1 1 1 0 0 0 1 1 1 1 0 0 0 1 0 0 1 1 1 1 1 0 0 1 0 0 1 1 0 1 1 0 0 0 1 1 1 1 0 0 0 0 0 0	0 0 0 1 1 1 0 0 0 1 0 0 1 1 1 1 0 0 0 0 1 1 0 1 0 0 0 1 1 1 0 0 0 0 0 0

4. Conclusion

This separation algorithm is designed to separate black object in binary image and can be adapted to other cases. By seeing to the result of experiments mainly on the weakness, the algorithm potentially can be developed into n-layer separation in a recursive function. The algorithm also potentially can be developed in adaptive to determine when to use vertical or horizontal separation first. It is expected to reduce the recursive number.

References

[1] Zhi Qiao, et al. A Wavelet-based Algorithm for Vehicle Flow Information Extraction. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2013; 11(1): 411-416.
[2] Shisong Zhu, Min Gu, and Jing Liu. Moving Vehicle Detection and Tracking Algorithm in Traffic Video. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2013; 11(6): 3053-3059.
[3] Aiyan Lu, et al. Moving Vehicle Recognition and Feature Extraction From Tunnel Monitoring Videos. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2013; 11(10): 6060-6067.
[4] Hongjin Zhu, Honghui Fan, and Shuqiang Guo. Moving Vehicle Detection and Tracking in Traffic Images based on Horizontal Edges. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2013; 11(11): 6477-6483.
[5] Ahad Karimi Moridani, Seyyedeh Hoora Fakhrmoosavy, and Mohamed Karimi Moridani**.** Vehicle Detection and Tracking in Roadway Traffic Analysis using Kalman Filter and Features**.** *International Journal of Imaging and Robotics*. 2015; 15(2): 45-52.
[6] Ratri Dwi Atmaja. Wood image real-time segmentation algorithm based on video processing. *International Journal of Imaging and Robotics*. 2015; 15(1): 12-18.
[7] Ratri Dwi Atmaja, et al. The Detection of Straight and Slant Wood Fiber Through slop angle fiber feature. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2015; 14(2): 318-322.
[8] Nobuyuki Otsu. A Threshold Selection Method from Gray-Level Histograms. *IEEE Transactions on Systems, Man, and Cybernetics*. 1979; 9(1): 62-66.
[9] Haralick, Robert M, and Linda G. Shapiro. *Computer and Robot Vision Volume I*. Addison-Wesley. 1992: 28-48.
[10] F.S. Najafabadi, and H. Pourghassem. Surface and Corner Defect Detection on Tile Images Using Gabor Features, Level Set Segmentation and Dot Product. *International Journal of Imaging & Robotics.* 2012; 8(2).

[11] Hong-an Li, Jie Zhang, Baosheng Kang. Image Deformation Based on Wavelet Filter and Control Curves. *TELKOMNIKA Indonesian Journal of Electrical Engineering.* 2014; 12(5).
[12] Ahmad Nazri Ali, and Mohd Zaid Abdullah. One Dimensional With Dynamic Features Vector For Iris Classification Using Traditional Support Vector Machines. *Journal of Theoretical and Applied Information Technology*. 2014; 70(1).
[13] Qu zhongshui. An Algorithm of Image Quality Assessment Based on Data Fitting of Image Histogram. *TELKOMNIKA Indonesian Journal of Electrical Engineering.* 2014; 12(1).
[14] Nur Shazwani Kamarudin, et al. Comparison Of Image Classification Techniques Using Caltech 101 Dataset. *Journal of Theoretical and Applied Information Technology*. 2015; 71(1).
[15] Ning Chen, Xiao-ping Song, Yi Liu. Edge Detection Based on Biomimetic Pattern Recognition. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2014; 12(9).
[16] Nadeem Mahmood, et al. Image Segmentation Methods And Edge Detection: An Application To Knee Joint Articular Cartilage Edge Detection. *Journal of Theoretical and Applied Information Technology*. 2015; 71(1).