Automatic Extraction Method for Vehicle License Plate Areas that is Robust to Changes in License Plate Size

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Abstract: Recognition of vehicle license plates is applied in various fields, such as traffic control, unmanned tollgate and parking lot operation, and illegal vehicle control. For the unmanned management of vehicles, various license plate sizes should be accommodated. However, conventional studies have limitations in managing the variability of the license plate area. In this paper, a method for extracting the vehicle license plate area for small to large license plates is proposed. A single image of a vehicle license plate is reduced and inputted in multiple steps using the pyramid technique, and then, the vehicle license plate areas extracted in stages are integrated in order to extract a candidate area of the vehicle license plate. When the license plate areas are integrated, they are first enlarged by applying reduction rates. A verification method for the candidate area is applied to the extracted candidate area in order to extract the final vehicle license plate area. The test results indicate that the extraction process is performed effectively beyond the variability of license plate areas. The extraction rate of the vehicle license plate candidate text area is 100% and the extraction rate of the final license plate area through verification is 98%.

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1. Introduction

Demands for vehicles have increasingly been increased due to the development of industrial society. Studies on the recognition of license plate in Korea has variously been conducted since the 1990s to utilize them to industrial fields such as efficiently control traffic, operate automatic tollgate and parking space and detect illegal vehicle. An automatic detection system can be used to detect vehicles which exceed speed limit or violate bus-only lane or to trace stolen car. In case of crimes related to cars, it is difficult to detect video data when collecting the information while the car is driving. Thus, various studies have been conducted to timely and correctly obtain such data.

There have been a lot of studies about extracting regions from license plates. When it comes to Intelligent Transport System (ITS), vehicle numbers have been used in a lot of fields such as in parking lot [1], automatic tollgate [2], detection for illegal vehicle [3] and speeding [4]. While edge component and mathematical morphology method [5][6] have generated excellent results, they are time-consuming. To address this problem, block-based algorithm [7] has been developed. Existing method detecting characters based on area has extracted subtitle area based on a texture analysis method [8] such as Gabo filtering or spatial variation analysis method [9]. The texture analysis method is not only sensitive to the size and typeface of text, but cannot accurately extract the text area. Moreover, it takes a lot of time. There is a method extracting text area assuming the texts are assembled and recognizing texts so that it could find the region of license plates [10]. It conducts binarization using various thresholds values and extract connected components from binarized results to extract license plates region [11]. It has weaknesses in that it needs to have prior knowledge about texts to extract text area using region split and merge method or using the difference between frames. Moreover, it is time-consuming since it processes the whole video. This paper is organized as follows. Chapter 2 describes the classification of license plate and problems to be solved. Chapter 3 describes methods of extracting license plate region varying in sizes. Chapter 4 suggests the results of the experiment and chapter 5 is about the conclusion.

2. The classification of license plate and the problem to be fixed

License plate varies in size and color depending on countries. License plates taken by devices can vary in size depending on the distance and be tilted from angles. In a place packed with cars like parking space, there can be more than one license place. License plates can be classified as follow. Figure 1 shows large plates, and Figure 2 shows small one. In Figure 3, there are two license plates in the video. Figure 4 shows tilted plates due to the angle.

(a) (b)

Figure 1. Large plates

(a) (b)

Figure 2. Small plates

(a) (b)

Figure 3. 2 plates in the video

(a) (b)

Figure 4. Tilted plates

The plate that needs to be detected can either be large or small or can be in the video where two places exist. In addition, it should detect tilted one. This paper suggests the extraction method of regions from varied license plates.

3. An extraction method for license plates of various sizes

3.1 Theoretical background of the extraction method for various license plates

Most of the methods extracting regions from a license plate are looking for the region by assigning the size beforehand since it is inevitable to use information on the size of the plate, prior knowledge, in extracting and examining the region. Then, I do we extract varying regions? The fundamental idea is in Figure 5.

Let's suppose that there are two videos; one is a video of small license plates (see Figure 1) and the other is a video of big license plates (see Figure 2). Extracting process of varying license plate is like the one in Figure 5. Based on the size of small plates, regions cannot be found in video 1 since the sizes of the plates are too big. The extraction can be re-tried by zooming a video n times (step 2), which would be impossible to find one since the standard is larger than the size of the basic plates (the size in the small plates). Video can be zoomed again n*n times (step 3). This time, it is possible to detect the license region since it is similar (identical) to the one in the basic plate. The region extracted in step 3 is a zoomed video and should be enlarged n*n times. Figure 6 shows the finally extracted license region and the region that can be found.

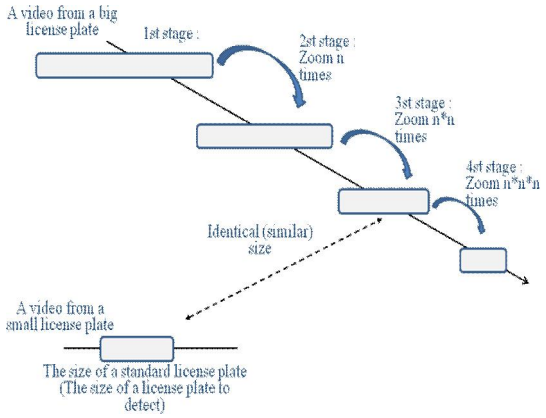

Figure 5. Extraction of plate region by zooming videos

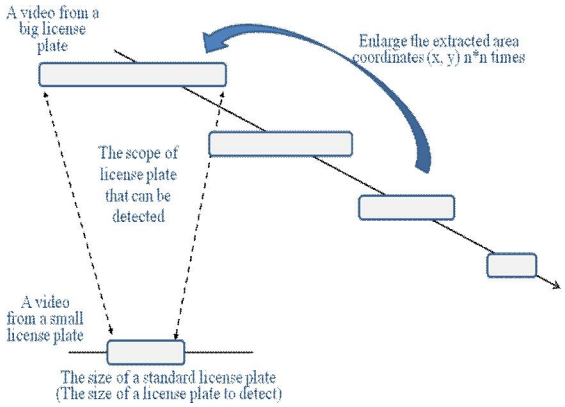

Figure 6. Scope of plate size that can be detected

3.2 The method of extracting region that can be a target for detection

The method of extracting region that can be a target for detection is shown in Figure 7. Conduct edge detection and edge binarization from the input image. Region forms when connecting adjacent components. Extract the region as a target for detection.

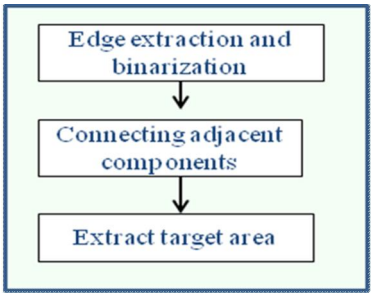

Figure 7. The method of extracting region that can be a target for detection

3.2.1 Edge detection and edge binarization

Perform edge detection of texts from license plates and do edge binarization to detect the target to be extracted.

3.2.2 Connecting the adjacent segment candidate region extraction through

Extraction algorithm for target region of texts consits of two steps. In the first step, if the strokes of texts are in certain distance, it is connected. Connected results are shown in Figure 8. The second stage is to eliminate the area if it is either too big or small. After these processes, target license plate area is extracted, which is shown in Figure 9.

Figure 8. Formed area

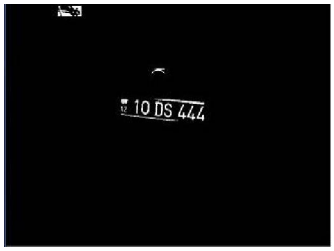

Figure 9. Extracted target area

3.3 Verification of target area

Through verification, the target area of extracted texts can be determined whether to belong to text. The verification process consists of two steps. The first step is to eliminate consisting components. Through labeling operation, extract components of extracted texts. Apply threshold value to the components of extracted texts to determine whether it is appropriate for the component and eliminate inappropriate one. The second step is to obtain text lines and compare the number of characters included in the lines so that it could extract text area. If the area is bigger than the pre-designated threshold value, it is regarded as text area. Figure 10 shows the text area extracted after the verification of the number of characters included in the area.

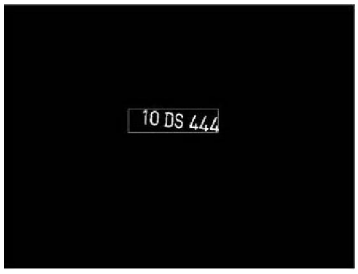

Figure 10. Plate area extracted after the verification of target area

3.4 Extraction method of license plate of variable size

Let me explain the extraction method of license plate of variable size presented in this paper.
In terms of entered video, it has to go through extraction step of target area and verification step. Target area can be extracted by zooming a video and then be verified. Zoomed video can again be zoomed to extract and verify target area. Verified target area can be integrated so that the final area can be extracted. Figure 11 show the extraction method of license plate of variable size. Figure 12 and 13 show areas extracted from the zooming processes. Figure 12 shows a result from the first zooming process,

which is larger plate than a standard plate area and thus, no plate area. Figure 13 shows the result of stage 4 zooming processes and represents that the plate area can be extracted since it is identical (similar) to the standard plate area. Figure 14 is the final plate area integrated through the 4 stages of zooming processes.

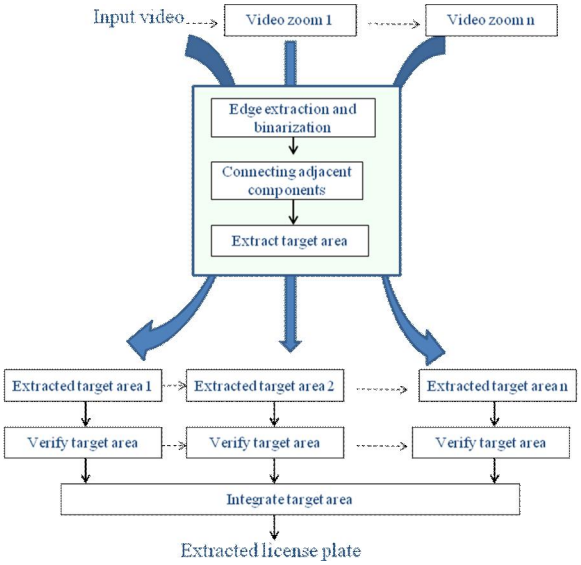

Figure 11. Extraction method of license plate of variable size

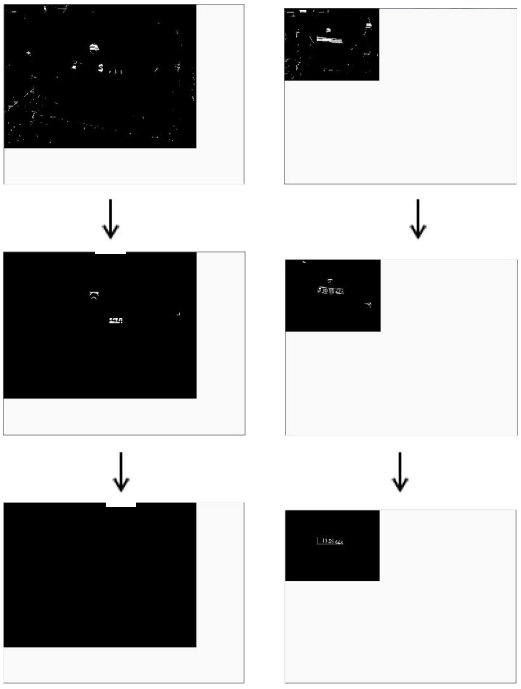

Figure 12. 1st stage of zooming process

Figure 13. 4th stage of zooming process

Figure 14. Extracted plate area after the final integration

4. Experiment

Effectiveness of the algorithm presented in this paper has been verified by Visual C++. Experimental data were the videos collected beforehand and were taken from different distances and angles so that it could text the result value depending on the changes in environment. A total of 2,978 images were used. Figure 15 shows the results of areas from big plates, Figure 16 from small plates, Figure 17 from multiple plates and Figure 18 from tilted plates.

Figure 15. The extraction result from a big license plate

Figure 16. The extraction result from a small license plate

Figure 17. The extraction result of multiple plates

Figure 18. The extraction result of a tilted license plate

The experiment suggests that extraction rate of target area was 100% and the final extraction rate through verification was 98.7%.

References

1. T. Sirithinaphong and K. Chamnongthai, “he recognition of car license plate for automatic parking system,”in Proc. 5th Int. Symp. Signal Processing and its Applications, pp. 455–57, 1998.
2. R. A. Lotufo, A. D. Morgan, and A. S. Johnson, “Automatic number plate recognition,”Inst. Elect. Eng. Colloquium on Image Analysis for Transport Applications, pp. 6/1–/6, 1990.
3. P. Davies, N. Emmott,and N. Ayland, “icense plate recognition technology for toll violation enforcement,” nst. Elect. Eng. Colloquium Image Analysis for Transport Applications,1990,pp.7/1-7/5.
4. Bailey,D.G.,D.Irecki,D.,Lim,B.K.,and Yang, L., (2002), “est bed for number plate recognition applications” Proceedings of the First IEEE International Workshop on Electronic Design, Test and Applications(DELTA’2),IEEE Computer Society.
5. B. Hongliang and L. Changping, “A hybrid license plate extraction method based on edge statistics and morphology,” in Proc. ICPR, pp. 831-834, 2004.
6. D. Zheng, Y. Zhao, and J. Wang, “An efficient method of license plate location,” Pattern Recognition. Lett., vol. 26, no.15, pp. 2431-2438, Nov. 2005.
7. H.J. Lee, S.Y. Chen, and S.Z. Wang, “Extraction and recognition of license plates of motorcycles and vehicles on highways,” in Proc. ICPR, pp. 356-359, 2004.
8. I. Pitas and C. Kotropoulos,"A textured-based approach to the segmentation of semitic image," Pattern Recognition. Vol.25, pp.929-945, 1992.
9. Y. Zhong, K. Karu, and A. Jain,"Locating text in complex color images," Pattern Recognition, vol.28, pp.1523-1535, 1995.
10. T. Naito, T. Tsukada, K. Yamada, K. Kozuka, and S. Yamamoto, "Robust license-plate recognition method for passing vehicles under outside environment," IEEE Tr. on Vehicular Technology, Vol.49, No.6, 2000, pp.2309-2319.
11. J. Matas and K. Zimmermann, “nconstrained license plate and text localization and recognition,” 8th International Conference on Intelligent Transportation Systems, September 2005, pp.572-577.
12. Rainer Lienhart and Frank Stuber, "Automatic text recognition in digital videos," Proc. of the SPIE, Image and Video Processing IV, Vol. SPIE2666, pp.180-188, San Jose, 1996.
13. Shoji Kurakake, Hidetaka Kuwano and kazumi Odaka, "Recognition and visual feature matching of text region in video for conceptual indexing,"
14. Proc. of the SPIE, Storage and Retrieval for Image and Video Database V, vol. SPIE3022, pp.368-378, San Jose, 1997.
15. Byung Tae Chun, Younglae Bae, Young Kyu Yang, "Generalized Caption Extraction Method Using Multi-Level Feature Extraction", Workshop on Image Processing and Image Understanding (IPIU2000), 2000. Jan, pp.78~84.

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