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Proceedings of the International Conference on Advanced Computer Science and Information Systems (ICACSIS 2009)

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Welcome Message from General Chairs

On behalf of the Organizing Committee of this International Conference on Advanced Computer Science and Information System 2009 (ICACSIS 2009), we would like to extend our warm welcome to all of the participants and speakers, in particular, we would like to express our sincere gratitude to those who give plenary speeches.

This conference is organized by Faculty of Computer Science - Universitas Indonesia. This conference is intended to be a first step toward an Asian-Europe conference on Computer Science and Information System. We believe that this International Conference will give opportunities for sharing or exchanging original research ideas and opinions amongst members of Indonesian research communities, together with researchers from Japan, Germany, Singapore, and Malaysia.

This conference focuses on the development of computer science and information systems. Along with 5 plenary talks, the proceeding contains 75 papers that are presented during the conference. This ICACSIS 2009 conference receives a total of 100 submissions from nine different countries. Among those paper submissions, 75 papers are accepted in the conference program.

We hope that all participants enjoy the program and gain inspiration for future research. We would like to take this opportunity to express our sincere appreciation to the members of the Program Committees for the careful review of the submitted papers, as well as the Organizing Committees for devoting their time and energy in making the program fruitful and for editing the proceeding. We would also like to appreciate the authors who have submitted excellent papers for this conference. Last but not least, we would like to extend our gratitude to Minister of Education and Minister of Communication and Information Technology - Republic of Indonesia for their continuous supports, to Rector and Dean of Computer Science Faculty of Universitas Indonesia for their supports for the ICACSIS 2009 conference.

Mirna Adriani

R. Yugo K. Isal

Welcome Message from Dean of Faculty of Computer Science Universitas Indonesia

On behalf of all the academic staff and students of the Faculty of Computer Science, Universitas Indonesia, I would like to extend our warmest welcome to all the participants to the Auditorium of the Centre for Japanese Studies, Universitas Indonesia on the occasion of the International Conference on Advanced Computer Science and Information Systems (ICACSIS) 2009.

I believe that ICASIS 2009 will play an important role in encouraging activities in research, development, and applications of computer science and information technology in Indonesia and give an excellent opportunity to create a collaboration between universities, research institutions, and companies for development of computer science & information technology both within the country and with international partners.

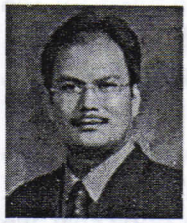
The broad scope of this event, which includes both theoretical aspects of computer science and practical, applied experience of developing information systems, provides a unique meeting ground for researchers spanning the whole spectrum of our discipline. I hope that over the next two days, some fruitful collaborations can be established.

I would like to express my sincere gratitude to the distinguished plenary speakers for their presence and contributions to the conference. I also thank all the program committee members for their efforts in ensuring a rigorous review process to select high quality papers.

Finally, I sincerely hope that all the participants will benefit from the technical contents of this conference, and wish you a very successful conference and an enjoyable stay in Depok, Indonesia.

Sincerely,
Professor Dr. T. Basaruddin
Dean

Welcome Message from Rector of Universitas Indonesia



Ladies and Gentlemen, participants and guests of the International Conference on Advanced Computer Science and Information Systems 2009 (ICACSIS 2009), Good Day, Assalamu'alaikum Wr. Wb.

Ladies and gentlemen, let me first express my gratitude toward our honorary chairs, Mr. Mohammad Nuh and Mr. Tifatul Sembiring, and to our honored speakers from abroad, who have spared their valuable time to make important contributions to this conference. I also give my best regards to our partners who, by their important cooperation, have made this conference possible. And, also, to all of our distinguished participants who make it here to participate, over the next two days, in academic discussions on advanced computer science and information systems.

In today's information age, it seems that there is no longer an aspect of life that is unaffected by the advances of information and communication technology, or ICT. For example, metropolitan cities such as Jakarta face problems of huge scope that can be supported by ICT, such as provision of adequate goods & services, including e-Learning, e-Health, intelligent transport management, as well as facilitating social communication. Universitas Indonesia recognizes that ICT has a huge role to play in addressing these issues and is committed to conducting cutting-edge research on how ICT can further solve these problems. A holistic approach is required – one that involves (i) pushing the theoretical and scientific frontiers of computer science, and (ii) implementing practical and applied approaches to information systems that can help society and various stakeholders. I welcome this ICACSIS 2009 event as being a meeting point of these two approaches.

In addition, such advances bring pride to the nation—to be *avant garde* in a progress towards bringing welfare and freedom to its people. Universitas Indonesia has determined to be *avant garde* for the nation's development. As an institution for higher education, Universitas Indonesia has put its mind towards becoming a *world class Research University*. The distinguished criteria for considering a university to be called a research university is how the higher education institute could make impact towards society, which by one of the oldest consensus is measured by the capability of that university to produce scientific knowledge that elevate people's lives. And that could never be achieved by blind belief toward a textbook knowledge, and on the pole, blind skepticism toward the others.

There should be a dialogue, between the nation and its contextual problem, which is done by continuous research activity. But there should also be dialog between nations, a mutual process of exchanging ideas which not put any nation as object, but akin to solving a puzzle that can only be collaboratively completed when each nation brings its own piece of the puzzle. Universitas Indonesia, which has been the leading in academic and research sector in the country, now moves forward to carry the Indonesian flag to play an important role in international academic dialogue to guide the world to a better future.

Thus, this conference contains two important objectives, as for our interest toward developing advanced computer science and information systems. First, it is to disseminate the state of the art of research development on information and communication technology due to its significant prospect for Indonesia's future. Secondly, this conference is intended to provide a media for exchanging ideas and information concerning ICT.

Universitas Indonesia has a pool of qualified researchers and lecturers who are not only academics, but also prominent figures who tirelessly explore ICT to be implemented for the interest of society. I'm convinced that these scholars will bring valuable contributions to this discipline, and they will bring relevant implementation of their tireless research in this conference.

Finally, I want to convey my deep appreciation and gratitude to all of our distinguished participants. I hope this conference will be enlightening for all of us, and I also hope that we will be able to be continuously fruitful to be the flag carrier of the nation.

Rector of Universitas Indonesia
Prof. Dr. der. soz. Gumilar Rusliwa Somantri

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Color Segmentation for Extracting Symbols and Characters of Road Sign Images

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***Abstract*—This paper presents a color segmentation technique based on the normalized RGB chromaticity diagram for extracting symbols and characters of road sign images. The method separates blue color of the sign's background by utilizing the developed histogram on the RGB chromaticity diagram for selecting threshold automatically. The morphology operators are used to extract symbols and characters. From the experiments using real scene images with varying illumination, the proposed method could extract symbols and characters of road sign images properly.**

***Index Terms*—Color segmentation, RGB chromaticity diagram, objects extraction, guidance sign.**

I. INTRODUCTION

TRAFFIC signs are used to provide useful information to the drivers. In the driver assistance system, an automatic signs detection and recognition becomes an important aspect. Since colors are more useful information for the human perception, traffic signs are usually painted with colors contrast against the road environments. However, color information is sensitive to the lighting changes which occur frequently in the real scene. Therefore a robust algorithm is required to handle such problems.

There are many types of traffic signs, such as: a) regulatory signs (speed limit signs, no entry sign, etc); b) indication signs (pedestrian crossing sign, parking sign, etc); (c) warning sign (cross road sign, road work sign, etc); (d) guidance sign (destination and route information sign). Each type is characterized by the shape, color, and symbol or character contained on it. The interpretation of information contained in the regulatory, indication, and warning signs could be obtained by matching or classifying the sign to the reference signs. However, the scheme for the guidance signs is more difficult, because of the irregular symbols and the variation of characters. Thus it needs to extract the symbols and characters first before further process to interpret them.

Researches on extracting symbols and characters of the guidance signs were proposed in [1],[2]. In [1] they extracted characters (Japanese kanji and alphabets) and symbols (indicating road structure) by edge segmentation. To overcome the problem of illumination changes, they transformed the intensity image based on the intensity histogram of the image. The positions or regions of the characters are found by the histogram projection technique. Since symbols usually form a larger region, they use size information for separating symbols from characters. The similar approach was employed in [2] to extract Korean characters and symbols.

An edge-base detection method that integrates edge detection, adaptive searching, color analysis, and affine rectification was employed in [3] to detect text of the road sign. The method is divided into three stages, i.e. coarse detection of candidate text, color properties analysis, and geometry and alignment analysis. In the first coarse detection stage, a multi-scale Laplacian of Gaussian (LoG) edge detector was used to obtain an edge set for each candidate text area. Gaussian Mixture Model (GMM) is used to characterize color distribution of the foreground and background of road signs, more specifically, for each of the letters on the road signs. The text alignment is used to align characters, so that letters belong to the same context will be grouped together. The intrinsic features (font style, color, etc.) and the extrinsic features (letter size, text orientation, etc.) are used for text alignment.

In [4], a robust connected-component-based character locating was proposed to find characters in scene image from digital camera. First, color clustering technique based on the normalized RGB color space is used to separate the color image into homogeneous color layers. Then every connected component in color layers is analyzed, and the component-bounding box is computed. Then an aligning-and-merger analysis is proposed to locate all the potential characters. Finally, all potential characters will be identified by heuristic rules.

Another work for extracting characters in natural images was proposed by [5] to help visually impaired persons and blind persons recognize signs. They proposed an extraction method based on the Otsu's thresholding that is applied in all three-color channels. To filter out the false detections, they used selection rules based on the relative placement of connected-components.

Although color is sensitive to illumination changes, but since color contains more meaningful information, many researchers discussed above prefer to use the color segmentation as the initial process for extracting symbols and signs.

In general, existing color segmentation methods could be classified into: histogram-based method, boundary-based method, region-based method, and Artificial Intelligent (AI)-based method.

The histogram-based method basically fuses the thresholds obtained from the histogram of each color channel [6]. In the boundary-based method, edge detection is first performed to each color channel separately to find the boundary of objects. Then the resulted edges are merged to obtain the final edge image. The region-based method groups the pixels according to the homogeneity criteria. Examples of this method are region growing, split and merge algorithms [7]. AI-based method performs color segmentation by utilizing Artificial Neural Networks [8],[9], Fuzzy Logic [10], Genetic Algorithm (GA) [11].

In this paper, we propose a method to extract symbols and characters of road sign images based on the normalized RGB chromaticity diagram. The method is simple and effective for extracting particular colors usually used in the sign images. Furthermore the morphology operators are employed to extract symbols and characters of the sign images.

The organization of the paper is as follows. In section 2, the proposed method is presented. The experimental results and discussions are presented in section 3. Conclusion is described in section 4.

II. Proposed Method

A. Color Segmentation

In our previous works [12] [13], we proposed color segmentation based on the normalized RGB chromaticity diagram for detecting red color sign [12] and detecting human skin color [13]. Here we extend the approach to blue color thresholding for extracting symbols and characters of the guidance signs.

The normalized RGB chromaticity diagram is depicted in Fig. 1, where the chromaticity coordinates are r and g defined by

$$r = \frac{R}{R+G+B} \qquad (1)$$

$$g = \frac{G}{R+G+B} \qquad (2)$$

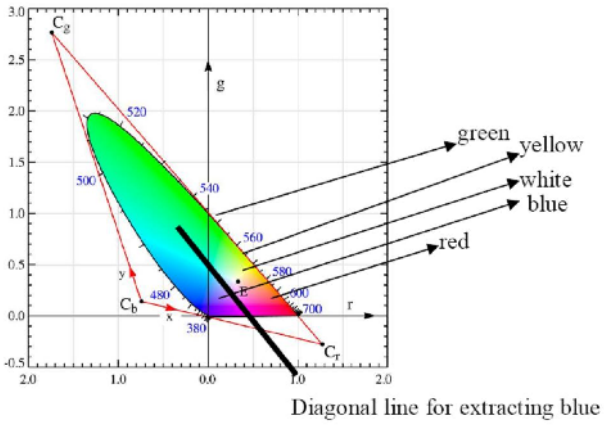


Fig. 1. Normalized RGB chromaticty diagram

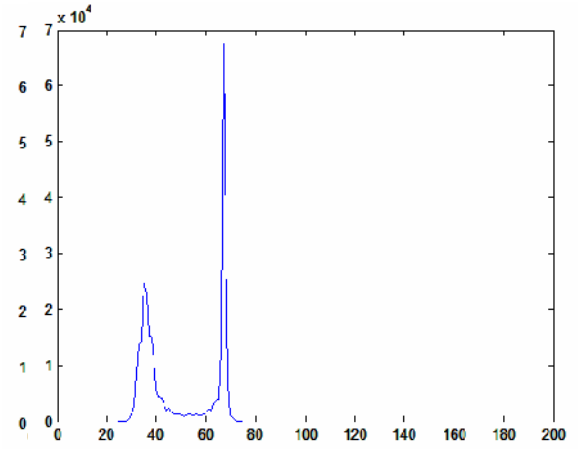


Fig. 2. *g_neg* histogram.

The diagonal line for extracting blue color is shown in the figure. This line is determined by the following equation

$$g = -r + TB \qquad (3)$$

where TB is the intersection of the line with g-coordinate. TB is calculated automatically by analyzing the peaks/valleys of the newly developed histogram called g_neg histogram [13]. The g_neg histogram is created by counting pixels with the value obtained by adding g value and r value (g + r). The effectiveness of the histogram is that it shows prominent peaks/valleys for easy threshold calculation. Thus by employing histogram peaks/valleys analysis, we may find the appropriate diagonal line for separating blue color. Fig. 2 shows the g_neg histogram with the prominent peaks, where the valley of histogram that determines the value of TB might be obtained easily.

From Fig. 1, it is clear that the blue color could be extracted by the following rule:

$$If \quad g + r < TB \quad then \quad pixel\ is\ BLUE \qquad (4)$$

B. Extraction of Symbols and Characters

The guidance sign used in the research contains three kind of information, i.e. characters (Japanese Kanji and/or Alphabet) indicating the city name or location; symbols indicating the road structure, and number indicating the route as illustrated in Fig. 3.

Fig. 3. *Guidance sign.*

As shown in Fig. 3, the symbols and characters are painted with white color in the blue background. Thus by employing the blue color segmentation as discussed above, we may separate the foreground (symbols and characters) from the background. The next step is to extract three kinds of objects (symbols of road structure, route number, and city name/location.

By observing Fig.3, the area of blue color of background inside the "small box" of route number is the largest one among the others, i.e. the ones inside the numbers or characters (Kanji and Alphabet). Thus, we may use the size information to find the region containing the route.

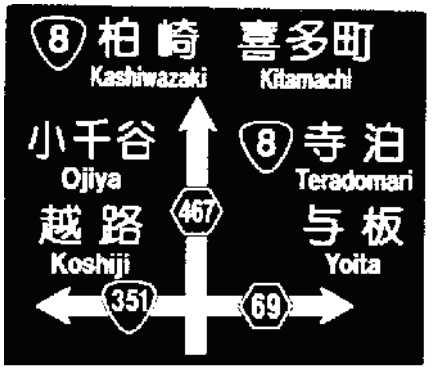
If we perform the connected component analysis to the extracted symbols and characters, i.e. the white color, we could find that the area of the symbols indicating road structure is the largest one. Thus we may use this restriction to extract the symbols. Finally, the remaining objects after the above two rules employed will be the characters.

III. EXPERIMENTAL RESULTS AND DISCUSSIONS

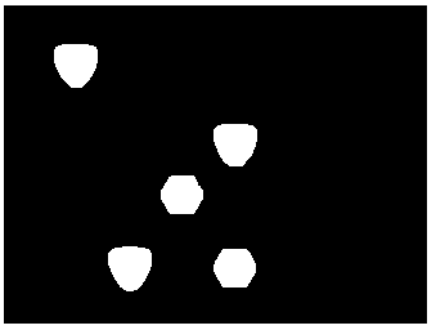
To verify our proposed method, we tested our algorithm using real scene sign images taken from a camera. The algorithm is implemented using MATLAB running on a Personal Computer (PC).

Fig. 4(a) shows the result of applying color segmentation of image in Fig. 3 using our proposed method as defined by Eq. (4). The histogram shown in Fig. 2 is the g_neg histogram of image in Fig. 3. Hence the threshold TB is obtained automatically by peaks/valleys analysis, i.e. 0.51. The method is able to separate blue color of the background from the foreground properly.

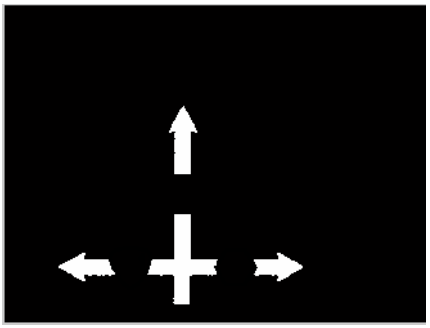
Fig. 4(b) shows the extracted boundary of route numbers, where all five boundary regions of the route numbers could be extracted from image successfully. The result of symbols extraction is shown in Fig. 4(c), where three arrows indicating route are extracted. Fig. 4(d) shows the extracted characters consist of Japanese Kanji and Alphabet.



(a)



(b)



(c)

(d)

Fig. 4. (a) Extracted symbols and characters; (b) Extracted boundary of route number; (c) Extracted symbol of road structure; (d) Extracted Japanese Kanji and Alphabet.

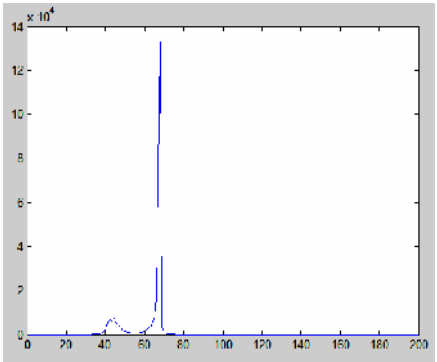
Fig. 5(a) shows the different image with the different illumination condition. The g_neg histogram of the image is shown in Fig. 5(b), where the value of obtained TB (TB=0.55) differs from the one in Fig. 2 as indicated by the different location of the valley. The symbols and characters are extracted properly as shown in Figs. 5(c), (d), (e), (f).

Compared to the existing method proposed in [1], our color segmentation method has two advantages: a) It could extract symbols and characters directly from the image without locating the road sign first; b) It could extract route number, while in [1], they do not extract the route number, but extract them as symbols together with the arrow indicating road structure.

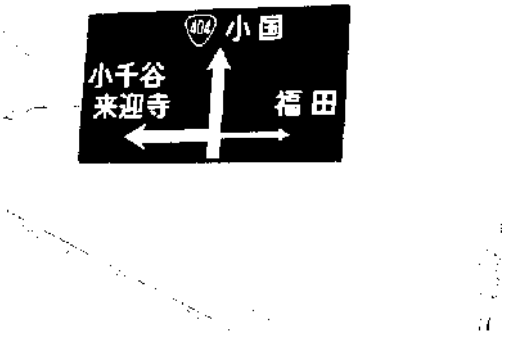
The first advantage of our method is cleary shown from Fig. 5. If we apply the method in [1] to the Fig. 5(a), it yields a wrong result as shown in Fig. 6, since the algorithm in [1] requires that image should be contained only two colors (background and foreground). Therefore, method in [1] needs to locate road sign first before extracting the symbols and characters.

The second advantage of our method could be shown in Fig. 4(b) and Fig. 5(d). Hence all route numbers, inside and outside the arrows are extracted. In contrast, since method in [1] do not extract the route number, but extract them together with the arrow instead, then the route numbers outside the arrows will be considered as characters.

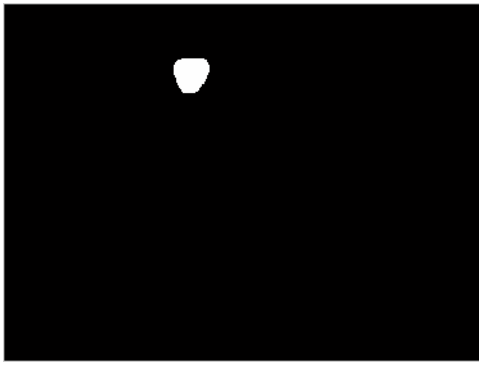
(a)



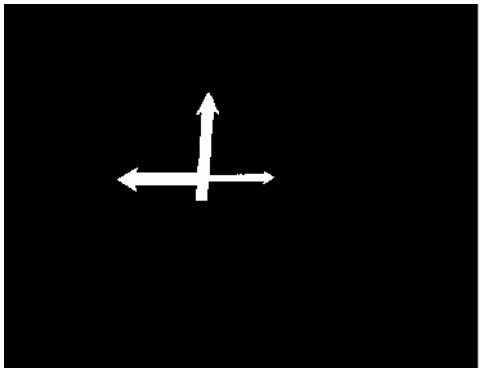
(b)



(c)



(d)



(e)

(f)

Fig. 5. (a) Original image; (b) g_neg histogram; (c) Extracted symbols and characters; (d) Extracted boundary of route number; (e) Extracted symbol of road structure; (d) Extracted Japanese characters.

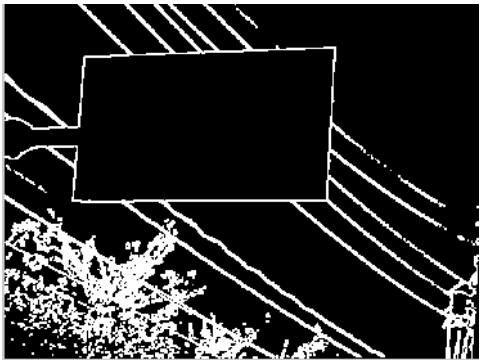


Fig. 6. Extraction of Fig. 5(a) using method in [1].

IV. CONCLUSION

In this paper, a color segmentation technique for extracting symbols and characters of road sign image is presented. The proposed method is based on the normalized RGB chromaticity diagram. From several experiments conducted, the proposed method shows a good result in extraction the symbols and characters.

In future, we will extend the work to perform the recognition process for recognizing or interpreting extracted symbols and characters. Further, the real implementation will be developed.

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