UNIVERSITI PUTRA MALAYSIA

REAL-TIME MALAYSIAN AUTOMATIC LICENSE PLATE RECOGNITION USING HYBRID FUZZY LOGIC WITH SKEW DETECTION AND CORRECTION METHOD

WISAM SALAH AL FAQHERI

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REAL-TIME MALAYSIAN AUTOMATIC LICENSE PLATE RECOGNITION USING HYBRID FUZZY LOGIC WITH SKEW DETECTION AND CORRECTION METHOD

By

WISAM SALAH AL FAQHERI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia

in Fulfilment of the Requirements for the Degree of Master of Science

January 2010

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Dedication

To those who offered me unconditional love,

To those who waited so long for this,

To my Family.

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Abstract of the thesis presented to the Senate of Universiti Putra Malaysia in Fulfilment of the requirement for the degree of Master of Science

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January 2010

Chairman : Syamsiah binti Mashohor, PhD

Faculty : Engineering

Automatic License Plate Recognition (ALPR) system is a mass surveillance method that uses optical character recognition on images to read the license plates on vehicles. This system has been used widely overseas. However, the different forms of Malaysian license plates still a problem that makes this system harder to be applied locally.

The proposed license plate recognition algorithm is aimed to recognize the different Malaysian license plates by employing two methods: Fuzzy Logic to recognize standard license plate (the plates which consist of characters and numbers), and Template Matching to recognize non-standard plates (the plates which consist of non-standard word and numbers).

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Mathematical Morphology is the first preprocessing step used to enhance Malaysian license plate image quality, by removing noise from the binarized image. The second step is to remove license plate borders by implementing Mathematical Morphology process with conditional statements. The third preprocessing step is a new Skew Detection and Correction (SDC) method proposed to correct the skewness of license plate image. License plate level testing follows the preprocessing step in order to check if the license plate is one or two rows (the license plate elements are in one or two rows). The standard and non-standard test is performed by checking if the input image is representing a standard or a non-standard plate. Vertical scanning (VS) and horizontal scanning (HS) have been used to segment license plate image elements. Segmentation process is the step where license plate elements are segmented. The next step is to forward the extracted characters and numbers to the Fuzzy Logic system to be recognized in case of standard license plates input, while forward non-standard words images to the Template Matching in order to be recognized in case of non-standard license plates input. The output of recognition step will be a string of numbers and characters which represent the recognized license plate.

The proposed M-LPR algorithm has shown an impressive result to recognize different Malaysian license plate forms. Fuzzy Logic system has been tested on standard license plate shows 92.16% recognition accuracy and 0.88 second processing time. The Template Matching shows 92% recognition accuracy and 1.06 second processing time when it is tested on non-standard license plate. The proposed SDC method has been evaluated by comparing with different other existing SDC methods such as Hough Transform, Projection Profile, Mathematical Morphology and Bounding Box methods.

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Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

PENGENALAN PLAT LESEN KENDERAAN MALAYSIA SECARA AUTOMATIK DAN MASA NYATA MENGGUNAKAN GABUNGAN LOGIK FUZZY DENGAN KAEDAH PENGESANAN DAN PEMBETULAN SERONG

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Sistem pengenalan plat kenderaan automatik (ALPR) adalah kaedah pengawasan jisim yang menggunakan pengenalan aksara optik ke atas imej untuk membaca plat kenderaan. Sistem ini telah digunakan dengan meluas di luar negara. Walaubagaimanapun, perbezaan bentuk pada plat kenderaan Malaysia masih menyebabkan masalah apabila sistem ini digunakan di dalam negara.

Algoritma pengenalan plat kenderaan yang dicadangkan bertujuan untuk mengenal perbezaan plat kenderaan Malaysia dengan menggabungkan dua kaedah: Sistem Logik Fuzi untuk mengenal plat kenderaan standard (plat yang mengandungi aksara dan nombor) dan Teorem Padanan Templat untuk mengenal plat kenderaan tidak standar (plat yang mengandungi perkataan tidak standard dan nombor).

Proses metodologikal adalah langkah prapemproses pertama untuk meningkatkan kualiti imej plat kenderaan dengan membuang hingar dari imej binari. Langkah

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kedua adalah membuang sempadan plat kenderaan menggunakan proses morfologi matematik dengan pernyataan bersyarat. Langkah ketiga prapemproses adalah kaedah pengesan kepencongan dan pembetulan (SDC) yang baru dicadangkan untuk membetulkan kepencongan imej plat kenderaan. Ujian tahap plat kenderaan mengikuti langkah prapemproses untuk memeriksa sama ada plat kenderaan adalah satu atau dua baris (unsur plat kenderaan adalah satu atau dua baris). Ujian standar dan tidak standar dijalankan dengan memeriksa sama ada imej input adalah plat standar atau tidak standar. Pengimbasan menegak (VS) dan pengimbasan mengufuk (HS) digunakan untuk mensegmen unsur di dalam imej plat kenderaan. Proses segmentasi adalah langkah dimana unsur di dalam plat kenderaan disegmen. Langkah seterusnya adalah membawa aksara dan nombor plat kenderaan yang telah dikeluarkan ke Sistem Logik Fuzi untuk dikenali sekiranya input adalah plat kenderaan standard, manakala perkataan yang tidak standard dibawa ke teori padanan templat untuk dikenali sekiranya input adalah plat kenderaan tidak standard. Output dari langkah pengenalan berbentuk aksara dan nombor yang mewakili plat kenderaan yang dikenali.

Algoritma M-LPR yang dicadangkan telah menunjukkan keputusan yang menarik untuk mengenal bentuk plat kenderaan Malaysia yang berbeza. Sistem Logik Fuzi telah diuji ke atas plat kenderaan standard dan menunjukkan 92.16% ketepatan pengenalan dan 0.88 saat masa memproses. Padanan Templat menunjukkan 92% ketepatan pengenalan dan 1.06 saat masa memproses apabila diuji ke atas plat kenderaan tidak standard. Kaedah SDC yang dicadangkan telah dinilai secara perbandingan dengan kaedah SDC berbeza yang telah ada seperti Pengubah Hough, Profil Unjuran, Morfologi Matematik dan kaedah Sekatan Kotak.

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I certify that an Examination Committee has met on ***DATE*** of viva voce to conduct the final examination of Wisam S. Al Faqheri on his Master degree thesis entitled " Malaysian License Plate Recognition (M-LPR) Using Fuzzy Logic and Template Matching with a New Skew Detection and Correction method" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the student be awarded the Master of Science.

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DECLARATION

I here by declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

Wisam S. Al Faqheri

Date:

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