



UNIVERSITI PUTRA MALAYSIA

SHADOW DETECTION USING COLOUR AND EDGE INFORMATION

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EDGE INFORMATION**



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**MASTER OF SCIENCE
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SHADOW DETECTION USING COLOUR AND EDGE INFORMATION

By

MARYAM GOLCHIN

**Thesis Submitted to the School of Graduate Studies, Universiti Putra
Malaysia in fulfilment of the requirement for the Degree of Master of
Science**

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DEDICATIONS

To Hashem,

My dear husband, for his unfailing support and contribution as an enormous and important portion of the fulfilment of this study.

To Taha,

My dear son, for his patience throughout the duration of my study.

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

SHADOW DETECTION USING COLOUR AND EDGE INFORMATION

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April 2013

Chairperson: Fatimah Binti Khalid, PhD

Faculty: Computer Science and Information Technology

Shadows appear in many scenes. Human can easily distinguish shadows from objects, but it is one of the challenges for Shadow Detection Intelligent Automated Systems. Accurate shadow detection can be difficult due to the illumination variations of the background and similarity between appearance of the objects and the background. Colour and edge information are two popular features that have been used to distinguish cast shadows from objects. Colour information is useful because information such as hue in HSI colour model, Y in $YCbCr$ colour model, the gradient of red, green and blue channels in RGB colour model are invariant in both shadow area and background, but information like intensity is different. Besides, the useful information for shadow detection is the cast shadow that does not have exterior edges. However, this become a problem when the difference of colour information between object, shadow and background is poor, the edge of the shadow area is not clear and the shadow detection method is supposed to use only for colour or edge information method. In this research,

a shadow detection method using both colour and edge information is presented. As a result, in the absence of colour information, the edge information is used and in the absence of edge information, the colour information is used. Shadow pixels are detected based on the colour information (using YC_bC_r , HSI, extended $c_1c_2c_3$ and hue difference of foreground and background). In order to improve the accuracy of shadow detection using colour information, a new formula is used in the denominator of original $c_1c_2c_3$. In addition using the hue difference of foreground and background is proposed. Furthermore, edge information is applied separately and the results are combined using a Boolean operator (logical AND).

In order to evaluate the performance of the proposed method, Shadow Detection Rate, Shadow Discrimination Rate, and Fscore from the extracted shadow image are computed. The above-mentioned factors are calculated and compared with each other in the following conditions namely detection using colour information method with different colour features, edge information method, and combination of these two methods. The experiments were done using VC++ 2008 with different standard indoor and outdoor data sets. These experiments investigate the performance of the proposed method in comparison with the Bangyu's method and Panicker's method which are based on colour and edge information. The results show the accuracy of detected shadow pixels is improved to 10%.

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

**PENGESANAN BAYANG-BAYANG MENGGUNAKAN MAKLUMAT
WARNA DAN PINGGIR**

Oleh

MARYAM GOLCHIN

April 2013

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Bayang-bayang muncul dalam banyak adegan. Manusia dengan mudah boleh membezakan bayang-bayang daripada objek, tetapi ia adalah salah satu cabaran untuk Sistem Automatik Pintar Pengesanan Bayang-Bayang. Pengesanan bayang-bayang yang tepat boleh menjadi sukar kerana variasi pencahayaan latar belakang dan persamaan antara penampilan objek dan latar belakang. Maklumat warna dan pinggir adalah dua ciri popular yang digunakan untuk membezakan bayang-bayang watak daripada objek. Maklumat warna adalah penting kerana maklumat seperti Hue dalam model warna HSI, Y dalam model warna $YCbCr$, saluran kecerunan merah, biru dan hijau dalam model warna RGB adalah tetap dalam kedua-dua kawasan bayang-bayang dan latar belakang, tetapi maklumat seperti Intensiti adalah berbeza. Maklumat yang berguna seterusnya untuk pengesanan bayang-bayang adalah bayang-bayang watak yang tidak mempunyai pinggir luar. Walaubagaimanapun, ini menjadi satu masalah apabila maklumat warna yang berbeza antara objek, bayang-bayang dan latar belakang adalah

rendah, pinggir kawasan bayang-bayang adalah tidak jelas dan kaedah pengesanan bayang-bayang yang sepatutnya digunakan hanya untuk kaedah maklumat warna dan pinggir. Dalam kajian ini, kaedah pengesanan bayang-bayang dengan menggunakan kedua-dua maklumat warna dan pinggir digunakan. Hasilnya, dalam ketiadaan maklumat warna, maklumat pinggir digunakan dan dalam ketiadaan maklumat pinggir, maklumat warna digunakan. Pikel bayang-bayang dikesan berdasarkan maklumat warna (menggunakan $YCbCr$, HSI, lanjutan $c_1c_2c_3$ dan warna yang berbeza terhadap latar depan dan latar belakang). Bagi meningkatkan ketepatan pengesanan bayang-bayang menggunakan maklumat warna, formula baru digunakan dalam penyebut formula asal $c_1c_2c_3$. Tambahan lagi, maklumat pinggir diaplikasikan berasingan dan hasilnya digabungkan menggunakan operator Booean (AND logikal).

Untuk menilai prestasi terhadap kaedah yang dicadangkan, Kadar Pengesanan Bayang-bayang, Kadar Diskriminasi Bayang-bayang dan Fscore daripada imej bayang-bayang yang diekstrak dikira. Faktor-faktor yang disebut di atas dikira dan dibandingkan dengan satu sama lain dalam keadaan berikut iaitu pengesanan menggunakan kaedah maklumat warna dengan ciri-ciri warna yang berbeza, kaedah maklumat pinggir dan gabungan kedua-dua kaedah. Eksperimen dilakukan menggunakan VC++ 2008 dengan set data dalaman dan luaran yang berbeza piawai. Eksperimen-eksperimen ini menyiasat prestasi terhadap kaedah dicadangkan dalam perbandingan dengan kaedah Bangyu dan Panicker yang berdasarkan kepada maklumat warna dan pinggir. Hasil kajian menunjukkan bahawa

ketepatan piksel-piksel bayang-bayang yang dikesan meningkat kepada 10%.



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MARYAM GOLCHIN

April 2013

I certify that a Thesis Examination Committee has met on 17 January 2013 to conduct the final examination of Maryam Golchin on her thesis entitled “**SHADOW DETECTION USING COLOUR AND EDGE INFORMATION**” in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The committee recommends that the student be awarded the Master of Science.

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

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Date: 17 January 2013

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