IMAGE ENHANCEMENT AND SEGMENTATION ON SIMULTANEOUS LATENT FINGERPRINT DETECTION

ROZITA BINTI MOHD YUSOF

MASTER OF COMPUTER SCIENCE

UNIVERSITI MALAYSIA PAHANG

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THESIS SUBMITTED IN FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF COMPUTER SCIENCE

FACULTY OF COMPUTER SYSTEMS & SOFTWARE ENGINEERING
UNIVERSITI MALAYSIA PAHANG

APRIL 2015

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion this thesis is satisfactory in terms of scope and quality of the award of the degree of Master of Science (Computer).

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I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of another degree.

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LIST OF ABBREVIATIONS

AVE-C	Analysis, Comparison, Evaluation and Verification
AFIS	Automated Fingerprint Identification System
AltHE	Alteration Histogram Equalization
CI	Correctly identified regions
CN	Crossing Number
C#	C-Sharp
FAR	False Accept Rate
FI	False identified regions
FIR	False Identified Rate
FFT	Fast Fourier Transform
FRR	False Reject Rate
HE	Histogram Equalization
MI	Missed identified regions
MIR	Missed Identification Rate
NIST	National Institute of Standards and Technology
ROI	Region of interest
SLF	Simultaneous Latent Fingerprint
SLFS	Simultaneous Latent Fingerprint Segmentation

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ABSTRACT

A simultaneous latent fingerprint (SLF) image consists of multi-print of individual fingerprints that is lifted from a surface, typically at the crime scenes. Due to the nature and the poor quality of latent fingerprint image, segmentation becomes an important and very challenging task. This thesis presents an algorithm to segment individual fingerprints for SLF image. The algorithm aim to separate the fingerprint region of interest from image background, which identifies the distal phalanx portion of each finger that appears in SLF image. The algorithm utilizes ridge orientation and frequency features based on block-wise pixels. A combination of Gabor Filter and Fourier transform is implemented in the normalization stage. In the pre-processing stage, a modified version of Histogram equalization is proposed known as Alteration Histogram Equalization (AltHE). Sliding windows are applied to create bounding boxes in order to find out the distal phalanges region at the segmentation stage. To verify the capability of the proposed segmentation algorithm, the segmentation results is evaluated in two aspects: a comparison with the ground truth foreground and matching performance based on segmented region. The ground truth foreground refers to the manual mark up region of interest area. In order to evaluate the performance of this method, experiments are performed on the Indian Institute of Information Technology Database-Simultaneous Latent Fingerprint (IIITD-SLF). Using the proposed algorithm, the segmented images were supplied as the input image for the matching process via a state art of matcher, VeriFinger SDK. Segmentation of 240 images is performed and compared with manual segmentation methods. The results show that the proposed algorithm achieves a correct segmentation of 77.5% of the SLF images under test.

ABSTRAK

Cap jari pendam serentak (SLF) terdiri daripada pelbagai imej cap jari seseorang individu yang diambil dari sesuatu permukaan kebiasaannya di tempat kejadian jenayah. Oleh kerana sifat dan kekurangan kualiti cap jari pendam tersebut, segmentasi menjadi tugas yang penting dan begitu sukar. Thesis ini membentangkan algoritma untuk segmen imej SLF seseorang individu. Tujuan algoritma ini adalah untuk mengasingkan bahagian cap jari dari latarbelakang imej dengan mengenalpasti bahagian ruas distal bagi setiap hujung jari yang hadir di dalam imej SLF tersebut. Algoritma ini menggunakan orientasi rabung dan kekerapan ciri berdasarkan blok piksel. Kombinasi *Gabor Filter* dan *Fourier transform* dilaksanakan di dalam peringkat normalisasi. Dalam peringkat pra-pemprosesan, perubahan versi *Histogram equalization* dikenali sebagai *Alteration Histogram Equalization* (AltHE) digunakan. *Sliding windows* diguna untuk membentuk *bounding boxes* bagi mengenalpasti bahagian ruas distal di peringkat segmentasi. Bagi mengesahkan keupayaan algoritma segmentasi yang dicadangkan, keputusan segmentasi dinilai melalui dua aspek: perbandingan dengan *ground truth* dan pemadanan berdasarkan bahagian segmentasi. *Ground truth* merujuk kepada bahagian yang diingini ditanda secara manual. Bagi menilai perlaksanaan kaedah ini, eksperimen telah dijalankan keatas pangkalan data Institusi Maklumat Dan Teknologi India- cap jari pendam serentak (IIITD-SLF). Menggunakan algoritma yang dicadangkan, kawasan-kawasan cap jari yang telah dikenalpasti dibekalkan sebagai imej input untuk proses perbandingan melalui pemadanan menerusi pemadan, *VeriFinger SDK*. Sebanyak 240 imej segmentasi dihasilkan dan dibandingkan dengan kaedah segmentasi secara manual. Keputusan eksperimen menunjukkan bahawa algoritma yang dicadangkan mencapai 77% segmentasi yang betul di bawah pengujian imej SLF.

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