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TITLE PAGE

UNIVERSITI TEKNOLOGI PETRONAS

A Hybrid Wavelet-based Motion Estimation Algorithm for Mobile Devices

By

Unan Yusmaniar Oktiawati

A THESIS

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PERAK,

2008

DECLARATION

I hereby 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 degrees at UTP

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ABSTRACT

In recent years there is a surge in demand for multimedia content like video-on-demand on personal digital assistance (PDAs), mobile telephones, and other mobile devices. However, these mobile devices have several constraints that is, limited processing, low display resolution, limited storage capacity, and relatively limited communication speed. While technological advances will reduce some of these constraints, mobile devices are likely to remain significantly less capable than their desktop counter parts. Therefore, research in video compression is necessary to reduce the storage memory.

In this research, a hybrid algorithm, utilizing the Dual Tree Complex Wavelet Transform (DTCWT) and the Adaptive Root Pattern Search (ARPS) block is used to perform the motion estimation. This new proposed algorithm first transform each video sequences with DTCWT. Real low pass sub-band filters are used to carry out the transform. The frame n of the video sequence is used as a reference input and the frame n+2 is used to find the motion vector. Next, the ARPS block search algorithm is carried out and this followed by an inverse DTCWT. The motion compensation is then carried out on each inversed frame n and motion vector.

The results show that a good compromise was achieved between computational complexity and image quality for mobile device which has limited memory without depriving its quality. The proposed algorithm also takes less memory usage compared to the DCT-based algorithm.

ABSTRAK

Sejak kebelakangan ini permintaan adalah tinggi terhadap aplikasi multimedia seperti penggunaan ‘video-on-demand’ sebagai pembantu peribadi digital (PDA’s), telefon mudah alih dan berbagai-bagai alatan multimedia yang lain. Walaubagaimanapun alatan multimedia ini mempunyai beberapa kelemahan antaranya pemprosesan yang terhad, paparan grafik yang rendah, ruang storan yang terhad dan kepantasan penyampaian maklumat yang terhad. Dengan adanya kemajuan teknologi terkini ianya dapat mengurangkan serba sedikit kelemahan yang ada namun masih mengekalkan masalah yang sama pada ‘desktop’. Oleh itu penyelidikan kemampatan video ini adalah bersesuaian untuk mengurangkan masalah menyimpanan maklumat.

Di dalam penyelidikan ini, satu kaedah kombinasi melibatkan ‘Dual Tree Complex Wavelet Transform’ (DTCWT) dan ‘Adaptive Rood Pattern Search’ (ARPS) digunakan untuk melakukan ‘motion estimation’. Kaedah baru ini dimulakan dengan menukar setiap video dengan ’DTCWT’. Penapis laluan rendah digunakan untuk menukarkan kerangka n dari video digunakan sebagai input acuan dan kerangka n+2 digunakan untuk mendapatkan ’motion vector’. Kemudian, kaedah ’ARPS’ dijalankan dan diikuti dengan songsongan DTCWT. ’Motion compensation’ kemudian dilaksanakan kepada songsongan daripada kerangka n dan ’motion vector’.

Hasil menunjukkan bahwa ada keserasian yang baik diperolehi diantara pengiraan yang kompleks dan kualiti imej untuk telefon mudah alih yang mempunyai memori yang terhad tanpa mengorbankan kualiti. Kombinasi antara kaedah yang digunakan juga mengurangkan memori yang diperlukan dibandingkan dengan kaedah yang berdasar kepada DCT.

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ACRONYMS

DCT	:	Discrete Cosine Transform
DTCWT	:	Dual Tree Complex Wavelet Transform
ARPS	:	Adaptive Rood Pattern Search
DWT	:	Discrete Wavelet Transform
FFT	:	Fast Fourier Transform
MPEG	:	Moving Picture Expert Group
3D	:	3 Dimension
2D	:	2 Dimension
RGB	:	Red Green Blue
SNR	:	Signal to Noise Ratio
ES	:	Exhaustive Search
TSS	:	Three Step Search
NTSS	:	New Three Step Search
SES	:	Simple and Efficient TSS
4SS	:	Four Step Search
DS	:	Diamond Search
RDWT	:	Redundant Discrete Wavelet Transform
ITU	:	International Telecommunications Union
JPEG	:	Joint Picture Expert Group
MAD	:	Mean Absolute Difference
MSE	:	Mean Squared Error

CDS	:	Cross Diamond Search
SCDS	:	Small Cross Diamond Search
NCDS	:	New Cross Diamond Search
LDSP	:	Long Diamond Search Pattern
BMA	:	Block Matching Algorithms
MV	:	Motion Vector
SDSP	:	Small Diamond Search Pattern
FS	:	Full Search
ROS	:	Region Of Support
MME	:	Minimal Matching Error
ZMP	:	Zero-Motion Prejudgment
SAD	:	Sum of Absolute Difference
URP	:	Unit size Rood Pattern