Faculty of Information and Communication Technology

AN EFFICIENT PSYCHOVISUAL THRESHOLD TECHNIQUE IN IMAGE COMPRESSION

Ferda Ernawan

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AN EFFICIENT PSYCHOVISUAL THRESHOLD TECHNIQUE IN IMAGE COMPRESSION

FERDA ERNAWAN

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DECLARATION

I declare that this thesis entitled "An Efficient Psychovisual Threshold Technique in Image Compression" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

Name : FERDA ERNAWAN

Date : 20 August 2014

APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Doctor of Philosophy.

Signature	:	
Supervisor Name	:	DR. NUR AZMAN ABU
Date	:	22 August 2014

DEDICATION

I would like to dedicate this thesis to my beloved mother and father

ABSTRACT

Nowadays, psychovisual model plays a critical role in an image compression system. The psychovisual threshold gives visual tolerance to the human visual system by reducing the amount of frequency image signals. The sensitivity of the human eye can be fully explored and exploited in the qualitative experiment by describing what has been seen or by image quality judgment. However, the result of the psychovisual threshold through qualitative experiment depends on the test condition of the human visual systems and through repetitive viewing sessions. In a modern image compression, there is a need to provide some flexibility to obtain quality levels of the image output based on user preferences. The concept of psychovisual threshold is designed to determine quality levels of the image output. The psychovisual threshold represents an optimal amount of frequency image signals in image compression. This research proposes the psychovisual threshold through a quantitative experiment that can automatically predict an optimal balance between image quality and compression rate in image compression. The contribution of its frequency image signals to the image reconstruction will be the primitive of psychovisual threshold in image compression. It is very challenging to develop a psychovisual threshold from the contribution of the frequency image signals for each frequency order. In this research, the psychovisual threshold prescribes the quantization values and bit allocation for image compression. The psychovisual threshold is the basic primitive prior to generating quantization tables in image compression. The psychovisual threshold allows a developer to design adaptively customized quantization values according to his or her target image quality. The psychovisual threshold is also elementary and primitive for generating a set of bit allocation for frequency image signals. A set of bit allocation based on psychovisual threshold assigns the amount of bits for frequency image signals. A set of bit allocation refers to the psychovisual threshold instead of the quantization process in image compression. This research investigates the basic understanding of the psychovisual threshold in image compression. The experimental results provide significant improvement in the image compression. The psychovisual threshold which is presented as quantization tables, customized quantization tables and as a set of bit allocation gives a significant improvement on both of the quality of the image reconstruction and the average bit length of Huffman code. This research shows that psychovisual threshold is practically the best measure for optimal frequency image signals on image compression.

ABSTRAK

Model psikovisual memainkan peranan yang penting dalam sistem pemampatan imej pada hari ini. Ambang psikovisual memberi ketahanan terhadap sistem visual manusia dengan cara mengurangkan jumlah isyarat imej frekuensi. Sensitiviti mata manusia boleh diterokai dan dieksploitasi sepenuhnya melalui eksperimen kualitatif dengan cara menerangkan apa yang mereka telah lihat ataupun membuat penilaian ke atas kualiti imej. Walau bagaimanapun, hasil keputusan ke atas ambang psikovisual yang diperolehi melalui eksperimen kualitatif bergantung kepada keadaan ujian sistem visual manusia melalui sesi pemerhatian yang berulang kali. Dalam pemampatan imej yang moden, fleksibiliti sangat diperlukan bagi mendapatkan hasil akhir imej yang berkualiti mengikut kesesuaian pengguna. Konsep ambang psikovisual telah direka untuk menentukan aras kualiti hasil akhir imej. Ambang psikovisual ini mewakili jumlah optimum isyarat imej frekuensi dalam pemampatan imej. Kajian ini mencadangkan ambang psikovisual melalui eksperimen kuantitatif yang boleh meramal keseimbangan optimum antara kualiti imej dan kadar mampatan dalam sebuah pemampatan imej secara automatik. Isyarat imej frekuensi turut menyumbang untuk pembinaan semula imej yang menjadi kepada asas ambang psikovisual dalam pemampatan imej. Membangunkan ambang psikovisual daripada dapatan isyarat imej frekuensi bagi setiap aturan frekuensi merupakan satu cabaran. Dalam kajian ini, ambang psikovisual ditetapkan nilai pengkuantuman dan sejumlah bit untuk pemampatan imej. Ambang psikovisual merupakan asas utama bagi menghasilkan jadual pengkuantuman dalam pemampatan imej dan membolehkan pengguna merekabentuk nilai-nilai asas pengkuantuman adaptif yang boleh berubah mengikut kualiti imej sasaran. Ambang psikovisual juga menjadi asas kepada penghasilan sejumlah set bit untuk isyarat imej frekuensi. Penentuan sejumlah set bit ini berdasarkan kepada ambang psikovisual yang memberikan jumlah bit untuk isyarat imej frekuensi. Sejumlah set bit merujuk kepada ambang psikovisual dan menggantikan proses pengkuantuman dalam pemampatan imej. Kajian ini menyelidik asas ambang psikovisual dalam pemampatan imej. Keputusan kajian menunjukkan terdapat peningkatan yang ketara dalam pemampatan imej. Ambang psikovisual ditunjukkan dalam bentuk jadual kuantisasi, jadual kuantisasi reka bentuk khusus dan sejumlah set bit untuk memberi peningkatan yang ketara pada kedua-dua kualiti pembinaan semula imej dan purata panjang bit kod Huffman. Kajian ini menunjukkan bahawa ambang psikovisual adalah ukuran terbaik mengoptimumkan isyarat imej frekuensi dalam pemampatan imej.

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AC	-	Alternative Coefficient
ACY	-	Alternative Coefficient Luminance Y
ACCb	-	Alternative Coefficient Chrominance Cb
ACCr	-	Alternative Coefficient Chrominance Cr
DC	-	Direct Coefficient
DCY	-	Direct Coefficient Luminance Y
DCCb	-	Direct Coefficient Chrominance Cb
DCCr	-	Direct Coefficient Chrominance Cr
EOB	-	End-of-Block
NACY	-	Non-Peak Alternative Coefficient Luminance Y
NACCb	-	Non-Peak Alternative Coefficient Chrominance Cb
NACCr	-	Non-Peak Alternative Coefficient Chrominance Cr
PACY	-	Peak Alternative Coefficient Luminance Y
PACCb	-	Peak Alternative Coefficient Chrominance Cb
PACCr	-	Peak Alternative Coefficient Chrominance Cr
QF	-	Quality Factor
QS	-	Quality Scale
SF	-	Scaling Factor

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