UNIVERSITI PUTRA MALAYSIA

CELLULAR AUTOMATON FOR EFFICIENT IMPULSE NOISE REMOVAL AND EDGE DETECTION USING GRAPHIC PROCESSOR UNIT

AFSANEH JALALIAN

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BY

AFSANEH JALALIAN

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master

November 2010

Dedicated

To:

This thesis dedicated to my beloved husband, Babak Karasfi, to my dear and lovely daughter Parmida to my dear mother Tooba Soltanieh and my lovely father Hossein Jalalian that I owe them all of success in my life

Abstract of thesis presented to the Senate of Universiti Putra Malaysia, in fulfilment of the requirement for the degree of Master

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Chair: Khairulmizam b. Samsudin, PhD

Faculty: Engineering

Low cost sensors allow integration of image and video features in consumer devices. Increasing image resolution and pixel dimension requires high performance image processing technique preferably one that could be parallelize. In the last few years, Graphics Processing Units have evolved into more flexible and powerful data-parallel processors. Graphics Processing Units are economical and are advantageous in a wide variety of computer architecture. Recent developments in programmability and rapid growth in the performance of graphic hardware, has provided groundwork for using the architecture in alternative domains of graphics applications. In this respect, Cellular Automata could handle this requirement with its parallel architecture. The characteristic of cellular automata is found to be highly suitable for vector processor such as the Graphic Processor Unit and Field

Programmable Gate Array. In recent years the tendency to use of cellular automata in solving the problems of image processing has increased.

Noise removal and edge detection are fundamental operations, which commonly applied as pre-processing step before subsequent image processing tasks. One of the significant factors which degrade the performance of edge detector method is noise.

This thesis present Cellular Automata models for noise removal and edge detection of the distorted image by salt and pepper noise. In order to enhance the performance of the Cellular Automata model, a Graphic Processor Units programming approach has been adopted.

The results obtained show that the implemented Cellular Automata models are able to suppress noise and edge extraction in high noise intensity to 90 percents. The Cellular Automata models implemented on Graphic Processing Units have successfully outperformed the method implemented on Central processing Unit by factor of 2 for gray scale image and factor of 10 for colour images.

The results indicate that cellular automata executed on the Graphic Processor Units build a solid foundation for the wide variety of application in image processing.

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

CELLUL AR AUTOMATON BAGI PENYINGKIRAN HINGAR DEDENYUT DAN PENGESANAN TEPI MENGGUNAKAN GRAPHIC PROCESSOR UNIT

Oleh

AFSANEH JALALIAN

November 2010

Pengerusi: Khairulmizam b. Samsudin, PhD

Fakulti: Kejuruteraan

Penderia-penderia kos rendah membenarkan integrasi ciri-ciri imej dan video dalam alat-alat pengguna. Peningkatan dimensi resolusi imej dan piksel memerlukan teknik pemprosesan imej berprestasi tinggi yang sesuai serta bersiri. Dalam beberapa tahun yang lalu, Graphics Processing Units telah berkembang maju menjadi lebih fleksibel dan pemproses data-sesiri yang berkuasa. Graphics Processing Units lebih ekonomik dan berfaedah untuk pelbagai jenis seni bina komputer. Perkembangan terkini dalam pembangunan kebolehaturcaraan dan pertumbuhan pesat dalam prestasi perkakasan grafik, telah menyediakan asas untuk menggunakan seni bina ini dalam domain-domain alternatif bagi aplikasi grafik. Sehubungan dengan itu, Cellular Automata boleh memenuhi syarat ini dengan seni bina yang selari. Ciri-ciri Cellular Automata yang istimewa didapati amat sesuai untuk pemproses vektor seperti Graphic Processor Unit dan Field Programmable

Gate Array. Kebelakangan ini kecenderungan untuk penggunaan Cellular Automata dalam menyelesaikan masalah-masalah pemprosesan imej telah meningkat.

Penyingkiran hingar dan pengesanan tebing adalah operasi yang asas, pada kebiasaannya digunakan sebagai langkah pre- pemprosesan sebelum tugas-tugas pemprosesan imej berikutnya. Salah satu faktor penting yang mengurangkan prestasi kaedah pengesan pinggir ialah hingar.

Tesis ini mempersembahkan model Cellular Automata bagi penyingkiran bunyi bising dan pengesanan pinggir imej terherot dengan hingar garam dan lada. Bagi tujuan peningkatan prestasi, model Cellular Automata dibina dengan pendekatan pengaturcaraan Graphic Processor Units.

Keputusan yang diperolehi menunjukkan pelaksanaan model Cellular Automata berupaya mengurangkan hingar dan melaksanakan ekstraksi pinggir dalam keamatan hingar peringkat tinggi hingga 90 peratus. Model Cellular Automata yang dilaksanakan pada Graphic Processor Units telah berjaya mengungguli kaedah yang diterapkan pada Central Processing Unit sebanyak 2 faktor untuk gambar skala kelabu dan 10 faktor untuk gambar berwarna.

Keputusan menunjukkan Cellular Automata dilaksanakan pada Graphic Processor Units dapat dijadikan sebuah asas yang kukuh kepada pelbagai jenis aplikasi yang luas dalam pemprosesan imej.

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Afsaneh Jalalian

I certify that the a Thesis Examination Committee has been met on 4th of November, 2010 to conduct the final examination of Afsaneh Jalalian on her thesis entitled "Cellular Automaton for Efficient Impulse Noise Removal and Edge Detection using Graphic Processor Unit" in accordance with the Universities and University Collages Act 1971 and Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommended that the student be award the Master of Science degree.

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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 declared 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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AFSANEH JALALIAN

Date: 4 November 2010

TABLE OF CONTENTS