UNIVERSITI PUTRA MALAYSIA

RESOLVING SPATIAL CONFLICTS IN COMPUTER-GENERATED COLLISION DIAGRAMS FOR ROAD ACCIDENT ANALYSIS

AHMAD RODZI MAHMUD

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RESOLVING SPATIAL CONFLICTS IN COMPUTER-GENERATED COLLISION DIAGRAMS FOR ROAD ACCIDENT ANALYSIS

By

AHMAD RODZI MAHMUD

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirement for the Degree of Doctor of Philosophy

October 2002
Dedicated to my wife, Kausar, Khaulah and the rest of the families..............
Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Doctor of Philosophy

RESOLVING SPATIAL CONFLICTS IN COMPUTER-GENERATED COLLISION DIAGRAMS FOR ROAD ACCIDENT ANALYSIS

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AHMAD RODZI MAHMUD

October 2002

Chairman : Professor Ir. Dr. Radin Umar Radin Sohadi
Faculty : Engineering

This research deals with the depiction of road accident scenes using symbols. When cartographic symbols are presented, there may be situations where they are either too close or overlapping. Manual intervention is thus needed to rearrange the symbols to avoid confusing the user. This condition, known as spatial conflict, is part of the problem in cartography especially in the process of automated generalization.

When a collision diagram is drawn to show the road user movements (RUM) that indicate the nature of vehicle maneuver in road accidents at a particular site, the position of the event is often re-located because of the type and size of symbols used. The changes made are always tentative, iterative and subjective. It is
also a time consuming process, as the draughtsman need to decide the right and accurate symbols to be presented. These processes are needed, as the symbols are usually close or overlapping against each other. The diagram may not be much helpful to the traffic engineer if no intervention is being made to re-position the symbols. A clear and informative diagram is necessary to determine the predominant type of road accident, and for proposing the best remedy. Therefore, the procedures in the creation of Collision Diagram involve an iteration process which are subjective due to an array of human factors involved in making decisions. As a result, inaccuracy occurs in presenting the right position and the right symbols. Hence this work focuses on the automation process for resolving the spatial conflict.

The methodology proposed in this work is motivated by several approaches used in arranging objects in the form of circles within a limited space. Instead of plotting in rows, square or hexagons, the methodology implemented introduces some enhancement in geo-computation work to avoid wasting space and at the same time attempts to preserve topological relationships. An algorithm for resolving the spatial conflict in cartographic terms was designed and tested. Implementation of this technique enhances the methodology of creating Collision Diagrams, and maintains the topological relationships between the symbols. The
work undertaken is part of the phases in “knowledge construction process” specifically to solve spatial conflict issues.

The approach taken had enhanced the traditionally solution of re-arranging the position in rows to avoid any overlapping cases. Hence, the study contributes a methodology in resolving spatial conflict in the process of automated generalization. The output of this work is a spatial-conflict removal module written in Pascal. The data for this system is an accident database taken from a format generated by a package known as Micro Accident Analysis Package (MAAP) used by the Royal Police of Malaysia. The system module created from this work will assign a proper symbol for each accident event and will automatically refine its location. The format of the data being generated is in the form of relational database, which is easily transferred for further analysis in the Geographical Information System (GIS) environment.
Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

MENYELESAIKAN KONFLIK RUANG DALAM RAJAH PERLANGGARAN JANAAN-KOMPUTER UNTUK ANALISIS KEMALANGAN JALAN RAYA

Oleh

AHMAD RODZI MAHMUD

Oktober 2002

Pengerusi : Profesor Ir. Dr. Radin Umar Radin Sohadi
Fakulti : Kejuruteraan


Apabila rajah perlanggaran di lukis untuk menggambarkan sifat pergerakan kendaraan yang terlibat, lokasi bagi kejadian
tersebut biasanya disesuaikan dengan jenis dan saiz simbol yang tertentu. Perubahan yang dibuat biasanya bersifat sementara, berulangkali dan tidak menentu. Ia juga adalah satu proses yang mengambil masa yang lama kerana pelukis pelan perlu membuat keputusan untuk memilih simbol yang betul dan tepat. Proses ini diperlukan kerana simbol-simbol biasanya terlalu rapat atau bertindihan sesama sendiri. Rajah seperti ini tidak membantu kepada jurutera trafik sekiranya tiada campurtangan dilakukan untuk mengubahsuai kedudukan simbol-simbol tersebut. Satu rajah yang jelas dan bermaklumat adalah perlu bagi menentukan jenis kemalangan paling utama dan seterusnya boleh digunakan untuk mencadangkan cara terbaik memperbaiki permasalahan tersebut. Oleh itu kajian ini di fokuskan untuk menyelesaikan perselisihan data ruang dalam proses automasi generalisasi.

Kaedah yang di utarakan dalam kajian ini di motivasikan melalui pelbagai pendekatan dengan menyusun objek-objek berbentuk bulatan dalam satu ruang yang terhad. Kaedah yang dilaksanakan telah memperkenalkan beberapa peningkatan dalam kerja geo-hitungan untuk mengelakkan pembaziran ruang dan dalam masa yang sama memelihara hubungan topologi sesama objek. Ini adalah pengganti kepada kaedah pemplotan mengikut barisan, segiempat sama dan hexagon.
ACKNOWLEDGEMENTS

First and foremost, Alhamdulillah to the great al-Mighty, for giving me the inner strength and knowledge in making this work a reality. Secondly, I am much obliged to the Universiti Putra Malaysia for allowing and sponsoring my study.

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I am grateful to my head department, Assoc. Prof. Dr. Mohd Saleh Jaafar, and the previous head of departments, Assoc. Prof. Dr. Mohammad Razali and Assoc. Prof. Ahmad Jusoh who had been encouraging me all the while. I am indebted to Professor Abang Abdullah who was the Dean of the Engineering Faculty when the work started, for assisting and supporting my study.

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Jazallakallah hu khoiran kasira

Ahmad Rodzi Mahmud
I certify that an Examination Committee met on 17th October 2002 to conduct the final examination of Ahmad Rodzi Mahmud on his Doctor of Philosophy thesis entitled “Resolving Spatial Conflicts in Computer-Generated Collision Diagrams for Road Accident Analysis” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations, which have been duly acknowledge. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

AHMAD RODZI MAHMUD
Date:
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<td>Aerial Photos</td>
<td>Photograph taken from Aerial Camera, a form of remote sensing equipment to capture image of the earth features</td>
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<td>Algorithm</td>
<td>A logical step-by-step procedures in programming tasks</td>
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<td>AutoCAD</td>
<td>A computer aided drafting software by AutoDESK</td>
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<td>Blackspot</td>
<td>A location considered as prone to road accident</td>
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<td>Boolean</td>
<td>A special logic of great utility in computer data processing, based on \textit{and/or} operators and \textit{true/false} values</td>
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<td>Collision Diagram</td>
<td>A map of an accident blockspot showing the approximate positions and manoeuvres of the vehicles involved</td>
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<td>Data Structure</td>
<td>A way of organizing information</td>
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<td>DXF</td>
<td>An AutoCad data exchange file</td>
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<td>Entities</td>
<td>Things in real world</td>
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<td>Fatal</td>
<td>At least one person was killed or died within 30 days</td>
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<td>Geocomputation</td>
<td>Geometrical computation to address spatial analysis problem, knowledge construction and data mining in geography. Aims to enrich geographic with a toolbox of methods and model</td>
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<td>Generalization</td>
<td>A cartographic process in eliminating visual complexity of maps</td>
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<td>GIS</td>
<td>Geographic Information System</td>
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<td>Head-on</td>
<td>Crash type involving vehicles from adjacent approaches at an intersection or mid-block</td>
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<td>Knowledge Discovery</td>
<td>To provide some means of exploratory data pattern</td>
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<td>MAAP</td>
<td>Micro Analysis Accident Package</td>
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<td>Manoeuvring</td>
<td>Vehicles movement such as making U turns, reversing, emerging from a driveway/laneway/footpath/median, etc.</td>
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<td>Mosaic</td>
<td>A set of aerial photographs being assembled to form a photomap</td>
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<td>Near intersection</td>
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<td>Objects</td>
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<td>Pedestrian</td>
<td>Person other than a driver, passenger, cyclist or motorcyclist</td>
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<td>Photogrammetry</td>
<td>The science of making measurements on photographs</td>
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<td>Relational</td>
<td>A type of structure of a database storage which consist of rows and columns</td>
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<td>Database Representation</td>
<td>A set of conventions about how to describe a set of things (geographic features)</td>
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<td>RSRC</td>
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<td>RUM</td>
<td>Road User Movement</td>
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<td>Spatial Conflict</td>
<td>Symbols drawn overlapping on each other that is useless for visual analysis</td>
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<td>Topology</td>
<td>Properties of geometrical figures that are invariant under continuous deformation (adjacency, containment, overlap)</td>
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<td>Visualisation</td>
<td>Spatialised representations of non-geographic phenomena.</td>
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