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ADAPTATION OF SOCIAL NETWORK ANALYSIS FOR FACILITATING SPATIAL DIAGRAMMING DURING ARCHITECTURAL CONCEPTUAL DESIGN PHASE

ALI GHAFFARIAN HOSEINI

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ALI GHAFFARIAN HOSEINI

MASTER OF SCIENCE
UNIVERSITI PUTRA MALAYSIA

2008

ALI GHAFFARIAN HOSEINI MASTER OF SCIENCE 2008

ADAPTATION OF SOCIAL NETWORK ANALYSIS FOR FACILITATING SPATIAL DIAGRAMMING DURING ARCHITECTURAL CONCEPTUAL DESIGN PHASE

By

ALI GHAFFARIAN HOSEINI

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

August 2008

UPM

DEDICATION

"It is my honor to dedicate the results of a consequential two year study as a Master's degree dissertation to my parents

MOHAMMAD GHAFFARIAN HOSEINI & BEHJAT ANSARI

Whom without their support and assistance, I wouldn't be standing here"

ALI GHAFFARIAN HOSEINI

2008

ACKNOWLEDGEMENTS

"As a student, I would like to present my deep gratitude to my Master's supervisory committee members;

ASSOC. PROF. DR. RAHINAH IBRAHIM

AND

DR. RUSLI ABDULLAH

For assisting me in all fields to complete my studies at Master's level"

ALI GHAFFARIAN HOSEINI

2008

I certify that an Examination Committee has met on 13th November 2008 to conduct the final examination of Ali Ghaffarian Hoseini on his Master of Science thesis entitled "Adaption of Social Network Analysis for Facilitating Spatial Diagramming during Architectural Conceptual Design Phase" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the student be awarded the degree of Master of Science.

Members of the Examination Committee were as follows:

Suhardi Bin Maulan, PhD
Faculty of Design and Architecture
Universiti Putra Malaysia
(Chairman)

Elias @ Ilias Bin Salleh, PhD
Professor
Faculty of Design and Architecture
Universiti Putra Malaysia
(Internal Examiner)

Azizah Salim Binti Syed Salim, PhD
Associate Professor
Faculty of Design and Architecture
Universiti Putra Malaysia
(Internal Examiner)

Michelle Shumate, PhD
Assistant Professor
Department of Communication
University of Illinois at Urbana-Champaign
(External Examiner)

_____
HASANAH MOHD. GHAZALI, PhD
Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 13 November 2008

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of **Master of Science**. The members of the supervisory committee were as follows:

Rahinah Binti Ibrahim, PhD
Associate Professor
Faculty of Design and Architecture
Universiti Putra Malaysia
(Chairman)

Rusli Bin Hj Abdullah, PhD
Faculty of Computer Science and Information
Universiti Putra Malaysia
(Member)

_____

AINI IDERIS, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 13 November 2008

Abstract of thesis presented to the Senate Universiti Putra Malaysia in fulfillment of the requirements for the degree of Master of Science

ADAPTATION OF SOCIAL NETWORK ANALYSIS FOR FACILITATING SPATIAL DIAGRAMMING DURING ARCHITECTURAL CONCEPTUAL DESIGN PHASE

By

ALI GHAFFARIAN HOSEINI

August 2008

Chair: Associate Professor Doctor Rahinah Binti Ibrahim, PhD.

Faculty: Faculty of Design and Architecture

Designers have difficulty visualizing the end results of the projects during the initial architectural conceptual design phase. This research introduces a computational tool—Social Network Analysis (SNA)—commonly used in the communications field to study relationships between people for solving this visualization problem. The research intent was to affirm whether or not SNA can be utilized as a spatial planning tool during conceptual building design. The author posits that since the nodes and structural relationships between the nodes may have similar architectural characteristics, the tool would enable architects to make changes by moving any spaces on a floor plan while safely maintaining their spatial relationships to other spaces. In this research, the author developed a proof-of-concept model using an available SNA tool to facilitate spatial diagramming visualization during conceptual design phase. This study, tested the use of the SNA tool at four levels. The first level determined whether spatial relationship between functional spaces could be developed (such as the living room must be adjacent to the front entry). The second level was on setting priority values for the different nodes and the linkages. The third level determined whether this study could develop grouping relationships between

several functional spaces that have a common characteristic (such as public versus private spaces) on one horizontal plan. The final fourth level determined whether the author could develop multiple layers (such as multi floors) that are connected by one common connector (such as a staircase in a double-story house). The corresponding models are validated intellectually by visual comparison between the simulated model of this study and another diagramming by (Nooshin, 2001) that was developed manually. The author is most interested in the fourth level because complexity in the spatial diagramming exercises is caused by multi-layered spatial arrangements at the horizontal and vertical planes. This study provided guidelines in developing a prototype for a spatial diagramming tool, which architects can use to resolve visualization problems when conducting the architectural spatial diagramming.

Abstrak tesis yang dikemukakan kapada Senat Universiti Putra Malaysia sebagi memenuhikeperluan untuk ijazah Master of Science

ADAPTASI *SOCIAL NETWORK ANALYSIS* BAGI MEMBANTU PENRAJAHAN RUANGAN SEMASA FASA REKA BENTUK KONSEP SENI BINA

Oleh

ALI GHAFFARIAN HOSEINI

August 2008

Pengerusi: Profesor Madya Doktor Rahinah Binti Ibrahim, PhD.

Fakulti: Fakulti Rekabentuk dan Senibina

Kajian pengrajahan ruangan *(spatial diagramming exercise)* adalah sukar apabila pereka tidak dapat melihat hasil akhir yang menurut kehendak mereka. Kajian ini memperkenalkan sebuah alat komputerisasi—analisa jaringan social *(Social Network Analysia (SNA)*—yang umum digunakan dalam bidang komunikasi untuk mengkaji hubungan di antara manusia bagi menyelesaikan masalah visualisasi ini. Penyelidikan kami bertujuan untuk mengesahkan sama ada kita dapat menggunakan SNA atau tidak sebagai suatu alat perencanaan ruangan ketika proses mereka bentuk bangunan. Kami menganjurkan bahwa oleh kerana nodus dan hubungan struktur antara nod-nod mempunyai kesamaan ciri dalam bidang seni bina, alat ini mampu membantu arkitek membuat perubahan kepada pelan tata atur ruangan bangunan yang mampu mengekalkan hubungan struktur sesame ruangan. Pada penyelidikan ini, kami membangunkan sebuah model konsep pembuktian dengan menggunakan suatu alat SNA sediada untuk memfasilitasi visualisasi kajian penrajahan ruangan semasa fasa reka bentuk konsep bangunan. Kami telah menguji kegunaan alat SNA pada 4 tahap. Tahap pertama adalah untuk mengesahkan samada kita boleh membentuk hubungan struktur sesame ruangan berfungsi (seperti ruang tamu harus

bersebelahan dengan pintu masuk utama). Tahap kedua adalah untuk mengesahkan samada kita boleh menetapkan pelbagai peringkat keutamaan untuk setiap nodus atau hubungan struktur yang dibentuk. Tahap ketiga adalah untuk mengesahkan samada kita boleh membentuk hubungan di antara sekumpulan nod yang mempunyai ciri tertentu (seperti ruangan awam berbanding dengan ruangan peribadi). Tahap keempat pula adalah untuk mengesahkan samada kita dapat membangunkan pelan tatatur pelbagai tingkat (seperti bagi bangunan betingkat) yang dapat dihubungi dengan satu penghubung umum (seperti sebuah tangga pada rumah dua tingkat). Model-model yang dibentuk telah disahkan melalui kaedah intelektual menerusi perbandigan visualisasi hasil model dengan model yang dibuat secara manual oleh Nooshin (2001). Kami lebih terdorong kepada hasil pencapaian Tahap keempat karena tataatur ruangan yang kompleks adalah disebabkan oleh kepelbagaian lapisan penyusunan tatatur pada peringkat mendatar dan menegak. Kajian ini memberikan panduan kepada kami untuk membangunkan sebuah alat prototaip untuk tujuan penrajahan ruangan yang boleh digunakan oleh arkitek untuk menyelesaikan masalah visualisasi ketika berbincang dengan pelanggan masing-masing.

DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

_____

ALI GHAFFARIAN HOSEINI

Date:…….....

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LIST OF ABBREVIATIONS

1D-2D-3D-nD	One Dimensional- Two Dimensional- Three Dimensional- n Dimensional
ADT	Abstract Data Type
AIS	Artificial Intelligence Systems
BIM	Building Information Modeling (Computational Structural Engineering Software)
BMDP	Bio-Medical Data Processing
C4ISR	Command, Control, Communications, Computers and Intelligence, Surveillance, and Reconnaissance
CAD	Computer Aided Design
DIMACS	Center for Discrete Mathematics and Theoretical Computer Science
Dynagraph	Dynamic Graphs
Dynet	Dynamic Network
GRADAP	Graph Definition And Analysis Package
Graphisoft	Graphic Software
GraphML	Graph Markup Language
IT/ICT	Information Technology/Information and Communication Technology
KBS	Knowledge Based Systems
Matlab	Matrix Laboratory
MLE	Maximum Likelihood Estimation
NEOGOPY	Negative Entropy
NetDraw	Network Draw
NetMiner	Network Miner
NTDS	New Technology Design Systems

NURBS	Non-Uniform Rational B-Splines
SAS	Statistical Analysis Software
SEED	Software Environment to support the Early phases in building Design
SNA	Social Network Analysis
SPSS	Statistical Product and Service Solutions (formerly Statistical Package for the Social Sciences)
SYSTAT	The system for statistics
TCADS	Traditional Computer Aided in Design Systems
VR	Virtual Reality
VRS	Virtual Reality Systems

GLOSSARY OF TERMS

AutoCAD	Computational Architectural Software
AutoCAD® BIM®	Computational Structural Engineering Software
AutoCAD® Revit®	Computational Structural Engineering Software
BMDP	Statistical Analysis Software
B-spline	In computer graphics, a curve that is generated using a mathematical formula that assures continuity with other b-splines
Pajek	Computational Social network Analysis Tool
Socio-Gram	The visual representation of interaction in a group
Spline	In computer graphics, a smooth curve that runs through a series of given points

LIST AND WEBSITE OF THE MENTIONED SNA SOFTWARES

Agna 2.0.7	http://www.geocities.com/imbenta/agna/index.htm
Blanche 4.6.4	http://www.spcomm.uiuc.edu/Projects/TECLAB/BLANCHE/
FATCAT 4.2	http://www.sfu.ca/~richards/Pages/fatcat.htm
GRADAP 2.0	http://www.assess.com/Software/GRADAP.htm
Iknow	http://www.spcomm.uiuc.edu/Projects/TECLAB/IKNOW/
InFlow 3.0	http://www.orgnet.com/
KliqFinder 0.05	http://www.msu.edu/~kenfrank/software.htm
MultiNet 4.24	http://www.sfu.ca/~richards/Multinet/Pages/multinet.htm
NEGOPY 4.30	http://www.sfu.ca/~richards/Pages/negopy4.html
NetDraw 1.0	http://www.analytictech.com/downloadnd.htm
NetMiner II	http://www.netminer.com/NetMiner/home 01.jsp
NetVis 2.0	http://www.netvis.org/
Pajek 0.94	http://vlado.fmf.uni-lj.si/pub/networks/pajek/default.htm
PermNet 0.94	http://www.meijigakuin.ac.jp/~rtsuji/en/software.html
PGRAPH 2.7	http://eclectic.ss.uci.edu/~drwhite/pgraph/
ReferralWeb 2.0	http://www.cs.washington.edu/homes/kautz/referralweb/
SM LinkAlyzer	http://www.md-logic.com/id142.htm
SNAFU 2.0	http://innovationinsight.com/networks.html
Snowball	http://stat.gamma.rug.nl/snijders/socnet.htm
StOCNET 1.4	http://stat.gamma.rug.nl/stocnet/
STRUCTURE	http://gsbwww.uchicago.edu/fac/ronald.burt/teaching/
UCINET 6.05	http://www.analytictech.com/ucinet 5 description.htm
visone 1.0b1	http://www.visone.de/

JUNG 1.0	http://jung.sourceforge.net/index.html
MatMan 1.0	http://www.noldus.com/products/index.html?matman/index
PREPSTAR 1.0	http://kentucky.psych.uiuc.edu/pstar/index.html
SNA 0.41	http://legba.casos.ri.cmu.edu/R.stuff/
SNAP 2.5	http://www.soc.ucsb.edu/faculty/friedkin/Software/Software.htm
yFiles 2.1	http://www.yworks.de/en/products yfiles about.htm
KrackPlot 3.0	http://www.andrew.cmu.edu/~krack/
Mage 2.1	http://kinemage.biochem.duke.edu/kinemage/kinemage.html