

**THE DEVELOPMENT OF 3D VISUALIZATION AND WIRELESS
NETWORK**

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**“FOR MY PARENTS AND FAMILY
AND FOR THE PERSON
WHO ALWAYS STAND BY ME
NO MATTER HOW HARD THE LIFE IS
YOU KNOW WHO YOU ARE”**

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ABSTRACT

Wireless network coverage design is consist of 3 points at least and the right place to place the router is still remains as problem to designer of wireless network when designing the wireless network. The prediction of wireless signal is one of a good idea on how to design the wireless network. In large building area, the prediction to the wireless network is more important as it may contribute to the number of router that will be use. It also need to be predict because researcher need to know where is the best place to place the router so the signal generated will cover the hot spot of the building where lots of people using the wireless network at that place. The 2D simulation is already good and it does already exist in market but it is hard to show the real situation since in the real we one building is usually can be in multi-level building and it is easy to gain the file of the building design from the architect of the building. The main goal of the propagation modelling is to read real time data from the router to determine the effectiveness and to simulate the virtual environment in 3D so the wireless network can be predicted. It's a waste for example if in one building there are 2 routers but there is only one is used heavily by most users until they get low connection while the other one is not used because of the not strategic location place by the network designer. Hence, this research is to increase the capability of monitoring wireless network system in closed-area where most data is coming from both real and non-real data in order to simulate the environment and adjust the entire network when it requires using artificial intelligence technique. The primary focus of this research is to increase the quality of the signal strength in one building so that the signal is not wasted and the cost of building the wireless network can be minimize while maintaining the same or greater coverage.

ABSTRAK

Reka bentuk liputan rangkaian isyarat tanpa wayar terdiri daripada 3 titik dan tempat yang tepat untuk menempatkan router adalah masih kekal sebagai masalah kepada pereka rangkaian tanpa wayar apabila mereka bentuk rangkaian tersebut. Ramalan tentang isyarat tanpa wayar adalah salah satu idea yang baik tentang bagaimana untuk mereka bentuk rangkaian wayarles. Di kawasan bangunan besar, ramalan kepada rangkaian tanpa wayar adalah lebih penting kerana ianya akan menyumbang kepada bilangan router yang akan digunakan dalam rangkaian tersebut. Matlamat utama permodelan penyebaran adalah untuk membaca data masa nyata dari router untuk menentukan keberkesanan dan simulasi persekitaran maya 3D supaya rangkaian wayarles boleh diramalkan. Ia adalah satu pembaziran jika di dalam satu bangunan terdapat 2 router tetapi hanya satu sahaja yang digunakan sepenuhnya oleh kebanyakan pengguna sehingga mereka mendapat kelajuan yang rendah kerana kepadatan pengguna manakala router yang lain tidak digunakan kerana tempat lokasi yang tidak strategik oleh pereka rangkaian. Oleh itu, kajian ini adalah untuk meningkatkan keupayaan sistem pemantauan rangkaian wayarles di kawasan tertutup di mana kebanyakan data yang datang dari kedua-dua data sebenar dan bukan-sebenar supaya dapat merangsangkan alam sekitar dan melaraskan keseluruhan rangkaian apabila ia memerlukan menggunakan teknik kecerdasan buatan. Fokus utama kajian ini adalah untuk meningkatkan kualiti kekuatan isyarat dalam satu bangunan supaya isyarat tidak sia-sia dan kos membina rangkaian wayarles boleh meminimumkan masa yang sama mengekalkan liputan yang sama atau lebih besar.

CONTENTS

CHAPTER	TITLE	PAGES
	PROJECT TITLE	i
	DECLARATION	ii
	DEDICATION	v
	ACKNOWLEDGMENT	vi
	ABSTRACT	vii
	ABSTRAK	viii
	CONTENTS	ix
	LIST OF FIGURES	xi
	LIST OF ABBREVIATION	xiii
	 INTRODUCTION	 1
	1.1 Background	1
	1.2 Problem Background	2
	1.3 Research Aim	3
	1.4 Research Objective	3
	1.5 Scope of the Study	3
	1.6 Significance of the Study	4
II	 LITERATURE REVIEW	 5
	2.1 Introduction	5
	2.2 Wireless Cognitive Network	7
	2.3 Potential Uses of Platform	8
	2.4 Human Computer Interaction	10

	2.5	Computer Visualization	11
	2.6	Wireless Network Visualization	14
	2.7	HCI Design Factor for Computer Visualization	16
III		RESESARCH METHODOLOGY	18
	3.1	Introduction	18
	3.2	Project Implementation	18
	3.2	Research Procedure	21
	3.3	Gantt Chart	23
IV		RESULT AND ANALYSIS	24
	4.1	First Tools	24
	4.2	The Upgraded 3D Visualization of Wireless Network	26
	4.3	Analysis of the Simulation	29
	4.4	Finalized Tool	30
v		CONCLUSION	31
	5.1	Conclusion and Future Work	31
		REFERENCES	32
		APPENDIX	34

LIST OF FIGURES

FIGURE NO.	TITLE	PAGES
2.1	Screenshot form demo of Unreal 3 3D graphic tool; source: Epic Games Inc.	6
2.2	3D Visualization of Urban environment by El Hakim that could represent wireless networking in 3D environment (Sun et al., 2010).	9
2.3	2D Visualization of wireless network using Air Magnet Software (Source: Air Magnet).	15
3.1	Flow Chart For PSM 1	19
3.2	Flow Chart of Project	22
3.3	PSM Gantt Chart	23
4.1	Environment that are created by plotted coding using OpenGL programming	24
4.2	Texture that can be used in simulation to make a friendly user interface	24
4.3	Creating FKEKK environment using Autodesk 3D Max Studio 2012	25
4.4	Exporting Wavefront object in Autodesk 3D Max 2012	26
4.5	Setting for Wavefront object in Autodesk 3D Max 2012	26
4.6	Environment that being load into the tools	27
4.7	Examples of other software that can be used to	27

	create environment	
4.8	Signal propagation coverage	28
4.9	Visualization of wireless network at FKEKK using Visualization of Wireless Network Tools in 3D	29

LIST OF ABBREVIATION

LAN	-	Local Area Network
PC	-	Personal Computer
2D	-	Two Dimensional
3D	-	Three Dimensional
FPS	-	Frame per Second
HCI	-	Human Computer Interaction
LOD	-	Level of Detail
Wi-Fi	-	Wide Fidelity
Wi-LAN	-	Wireless Local Area Network
OpenGL	-	Open Graphic Library
.obj	-	Wavefront Object File Format
ISP	-	Internet Service Provider

CHAPTER I

INTRODUCTION

1.1 Background

The process of designing the wireless system in closed-area place such as office building and shopping complex still remains the big challenge. The wireless network should be planned carefully before we can place the access point or router in that area. Nevertheless, the prediction of the propagation signal is somewhat quite hard to implement in various type of environments even though it using the same topology of wireless network planning. The eventual objective of the propagation modelling is to find the suitable and fairness of acceptable performance of based on their signal strength. Based on the 3D visualization of the propagation modelling, the simulation can simulate the effective and efficient ways of router or access point placement, and the results will give the accurate info on us to predict how many router is needed in that place. The bad design of wireless network can lead to bad signal strength to entire network and the entire network should be redesign and rebuilt in order to fit the requirement set up by the various constraints.

This process will even increase the cost to measure all those things. One rough solution might be enough by just put in one strong base stations of wireless network to solve the problem but another problem may occurs where it might not become the proper solution as it may increases the cost of maintaining it in perfect shape. Based on this limitation, a tool that be able to simulate the whole conditions is required.

1.2 Problem Background

In general, the fundamental task of propagation modeling is to find the suitable location of router and access point carefully, so it can cover most of the area within the buildings according to user needs. The problem may exist later on after we realize the quantity of routers that needs to be installed inside or outside the building. The longevity of the router life is depend based on cost constraint. Regrettably, the problem is not always straight as it depends on various constraint of the building itself or rather the office management on construction site and equipment used. Given that there is many different parameters that always keep on changing, simplex approximation based on just finding the suitable place and numbers of router are not enough. Modern building are build by different types of materials that later on will be equiped with new office furniture which definitely bring huge impact to wireless network performance. The attenuation, reflections, multipath and other wireless network phenomena will increase the chance of using too much time just to modify the previously installed router.

The advantages of wireless network, e.g. no cables scattered through the compound, simple installation and the ability of the signal to be transmitted through doors and walls, has make it become popular everywhere . Unfortunately, the process of wireless network design and deployment still remain a big challenge [1]. Although proper prediction of signal propagation based on site-specific information and positioning of access points/routers have been carried out during planning stage, the performance of the designed wireless network is still not satisfy. This might due to the neglects of density and location of users within the wireless network during the design of signal propagation prediction phase. However, in real situation, this information is really useful in assisting the network to be re-optimized (maximize the Received Signal Strength (RSS) and throughput of a particular user at a specific location). An intelligent network, with the ability to self access and optimize according to the actual situation in the network, is needed to satisfy the needs of the users.

1.3 Research Aim

This project aim is to build software that can simulate the wireless network and visualized it using OpenGL and C++ programming to monitoring the wireless network.

1.4 Research Objective

The objectives for this research study are as follows:

- To develop a real-time visualization of cognitive network coverage prediction by using 3D graphics tools
- To perform reliability test on the visualization system by using high performance computer.
- To make a software that can easily use by importing the environment using third party 3D maker software

1.5 Scope of the Study

Our scope of study is to develop a 3D visualization tool for wireless network using OpenGL and C++ Programming. An environment that being created using 3D creating tools being used to create environment. The environment can be load into the tools and the visualization of the wireless signal can be done. The result can be used as the real life situation of the wireless network behaviour.

1.6 Significance of the Study

The significance of the study is to properly visualize the wireless cognitive network in interactive ways by using 3D visualization tools programmed by OpenGL and C++ Programming language. This could help the researcher to understand better the distribution of wireless signal strength in order to troubleshoot the problem that might occurs and improve the performance of wireless cognitive network.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

The increasing requirement for 3D software has tremendously becoming one of the common interest among researcher to develop a 3D visualization tools in order to provide very efficient monitoring system for either individual or commercial purpose. System such as wireless networking [2], health monitoring system, and other industrial related system that provides us with stunning 3D graphics tools to visualize most objects or environments. These tools helped them to understand better of the current situation without doing much works compared to the past time. In term of efficiency, it could produce one of the alternatives solutions to specific problems.

The current market for 3D visualization is extensively in rapid development where most of the country that produced game is increasing. Most of today games provide a unique environment using 3D visualization that will be capable of recreation of the real world on the regular personal computer. Game such as GTA IV, Modern Warfare 2, Midtown Madness, and thousands more produce very realistic virtual environment where become de factor of company to develop First Person Shooters (FPS) graphics engine. Almost every game, new technique of computer graphics is being introduced by provided new capabilities, allowing the birth of new 3D graphic tool that add various novel effects, such as particle effects, fog, colored lightning, as

well as increase texture and polygon detail. Many games featured large outdoor environments, vehicles, advanced physics and many more.

Additionally, 3D graphic tool is continue to produce a very realistic object creation where almost all objects can be destructible based on predefine physics environments. This object can be deform, destroy, and response in physically way just like the real world behavior. This is also brought many researchers to put attention on collision detection between those object. The result of collision of the object will bring the physic response towards the object. Unreal 3 engine which is the most advanced 3D graphic tool for today market has become widely use among commercial use by various company in order to produce their own games. Their software have multiple and lot of functionality in order to create powerful virtual world with less storage requirement.

A foretaste of the look of the newest technologies is visible on the Figure 1, where the real-time rendered scene from the Unreal 3 3D graphic tool [figure 2.1] is presented.



Figure. 2.1 Screenshot form demo of Unreal 3 3D graphic tool; source: Epic Games Inc.

As a result, this research intends to use the 3D graphic tool in order to visualize the corresponding wireless network in purpose of academic research and creation of realistic condition of wireless network in real world[3]. The general aim of this research is to come out with a 3D visualization of wireless network using 3D graphic tool that provide a realistic user experience while minimizing the time constraint in order to adjust the signal propagation.

2.2 Wireless Cognitive Network

The design of wireless system for wide area coverage where it consists at least 3 main points for router placement still remains the open problems for researchers to come out with good solution in terms of performance. Prediction of signal propagation from various sources of wireless router is very essential in order to main good quality of signal strength [4]. Consider there is wireless network install in a very big building where most people will be using wireless signal to surfing to the internet. Most of the users seems does not aware that the system that they are using is sometimes quite slow compare to its true performance of wireless networking [5]. If the management of the building does not carefully planning the allocation of those visitors or users that are currently using their internet access, most router that far from user will be abandon due to users mostly probably seat at the very convenience place to surf to the internet. This increase the problem of too many users accessing one router while other routers is not been use.

The main goal of propagation modeling or graphical modeling of wireless networking based on real-time data from router is to determine the effectiveness and the best coverage that can be simulated in virtual environment using 3D graphics. It simply to enhance the system so the monitoring of wireless networking will be more tolerated toward the user requirements. Hence, this research intends to increase the capability of monitoring wireless networking system in closed-area where most data is coming from both non and real time data in order to simulate the environment and adjust the entire network when it requires using artificial intelligence technique. This technique is called as wireless networking visualization using 3D graphical views based on real-time data application. The primary focus of this research is to helps increase the quality signal strength of wireless networking system without additional cost of using too much router on the same place.

2.3 Potential Uses of Platform

The research of 3D visualization for signal propagation is to simulate the prediction of the system in virtual environment. Prediction is always the essential task in wireless network planning. We have been divided the application of the system into several areas:

- **Pre-design:** The process of building a prototype where user be able to see the possible wave propagation before actual system is built;
- **Radio planning:** Where user is designed and implemented the system;
- **Optimization:** Performed optimization or improvement over the previous 3D visualization method of wireless cognitive network;
- **Evaluation,** Analysis of real time data where the data that is received will be investigated its efficiency and reliability.

These areas can become flexible between each other and some areas are quite hard to find the difference. With multiple functions that might have in 3D visualization tool that will be developed, user is able to use them to conduct a research and data collection. For example, user can conduct radio coverage analysis, collect real-time data of signal propagation, check the quality of signal strength within specific areas, check for service availability and compare the measurement of signal prediction. Some extra functions might be implemented in the future or as extra features such as visualization of packet loss, determine the accuracy of triangulating location, and reporting any impact of signal propagation using mobile application.

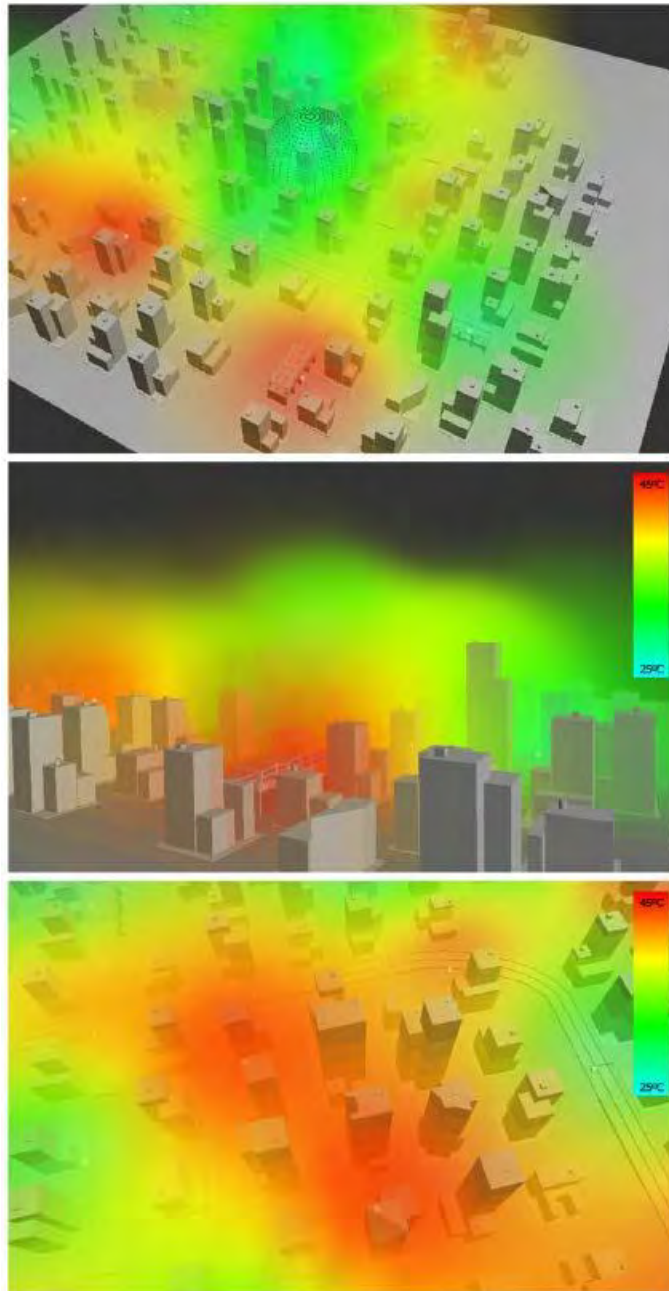


Figure. 2.2 3D Visualization of Urban environment by ElHakim that could represent wireless networking in 3D environment (Sun et al., 2010).

2.4 Human Computer Interaction

The first term of Human Computer Interaction was started almost few decades ago when it is originally founded by the B. Shackel, an American scholar in 1959. From Shackel, he introduced the very first document that explains the operational of the machine by using a panel of computer. Even though the technology seems to be limited during that time, the evolutionary of computer technology is starting to develop during the era. Later in 1960, Liklider JCK performed a study regarding the Man-Machine Interface Study where he came out with a concept of using a device that is capable to efficiently perform adequate interaction between human and computer.

Later in the early 1980s, HCI development is begin to be considered as newest researches during the era. At least six monographs have been published and the rapid development of HCI theory and practice system has emerged. Since that time, the development of HCI is continue to arise ranging from various area such as cognitive psychology, sociology as well as behavior, and in practice, the human- machine interface.

The interaction between human and computer to control the machine has continuing to improve for many years. Given that the starting of computer software called operating system in 1980s, Microsoft introduced Windows 3.1 that enable the user to communicate with the computer by using a device called mouse. Instead of using keyboard to type on the screen for the previous version of Windows, user is able to use mouse to navigate through the screen and click on the application that has been installed on the computer. The introduction of this device has led many companies to start develop an application that capable to empower the user capability to do various important things. Three-Dimensional (3D) modeling, drawing, writing document with specific instruction, and lots more has becoming common among many computer users. Thus, the increasing demand of this software has become an opportunity to create job for people. HCI has lots of benefits from the starting point of its development.

2.5 Computer Visualization

The “visualization” term is commonly known as a projection of any diagrams, images, or animations using a certain medium to display on the screen. Back to few decades ago, the visualization of these projections is hardly to accomplish and scientist finding it is quite hard to do the physical experiments without getting into the risks of uncertain effects. Thus, when the computer technology has widely explored by the researchers to comprehend with the scientist researches, the growth of computer visualization has become one of important research area.

In computer visualization, all the data is visualized either in two-dimensional (2D) or three-dimensional (3D) object. For 2D object, it is consisted of at least two points that is connecting to each other and perform a line. A combination of the multiple lines is called 2D shape. 2D visualization has been acceptable among mathematician and scientist to draw graph and few others configuration. For 3D visualization, the combination of various 2D shapes in coordinate space of X, Y, and Z is called 3D object.

From the past two decades, 3D visualization played important roles in determines the successful research simulation and animation. From the animation perspectives, various animated movies already begin to use 3D visualization in order to make the movies more interesting and futuristic. For example, starting from the early 1990, Toy Story 3D animated movies have begun to shape our research interest in 3D visualization. Recently, Tron, Avatar, and 2012 films also implemented the 3D visualization in their movies just to attract the audience to watch beautifully the power of 3D visualization.

In simulation world, the 3D visualization is used to visualize the condition of certain object properties such as the physic of bouncing balls. Given the example of the bouncing balls, researchers were trying to give the best result by implementing a very good 3D virtual world that has nearly the same properties of our real world. The velocity, friction, and the object mass are calculated into the simulation in order to give