UNIVERSITI PUTRA MALAYSIA

EVALUATION OF CURRENT MUSIC SYNTHESIS SOFTWARE FOR RENDERING OF VARIOUS SYNTHESIS ALGORITHMS

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By

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Thesis Submitted in Fulfilment of the Requirements for the Degree of Master of Science in the Faculty of Human Ecology
Universiti Putra Malaysia

September 2000

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

EVALUATION OF CURRENT MUSIC SYNTHESIS SOFTWARE FOR RENDERING OF VARIOUS SYNTHESIS ALGORITHMS

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September 2000

Chairman: Minni Ang Kim Huai, Ph.D.

Faculty: Human Ecology

The ability to distinguish the usefulness of currently available music synthesis software for the application of various synthesis algorithms is the main focus of the research. The amplitude modulation (AM), ring modulation (RM), frequency modulation (FM), additive synthesis and granular synthesis algorithms were used and applied into the WaveCraft [specialised graphical user interface software], Cool Edit Pro [digital audio editor software] and Csound [command-prompt type software] synthesis software. These softwares were chosen and categorised according to the software interface. Cool Edit Pro, a commercial or digital audio editor and not specifically a synthesis software, can however be used for this purpose. Due to the accelerated development in music synthesis software, there is an increasing number of new software now with no precise definition of

software characteristics to determine their usefulness has been described. Thus, in this project, a Music Software Evaluation (MSE) metrics table with exact definition and criteria in determining the usefulness of music synthesis software was designed and used to evaluate the usefulness of these softwares. Questionnaires were designed based on the MSE metrics table to gauge information on the different features available in the three music synthesis software and also from individuals about their expectations and experience with regards to the softwares. Results from these research findings indicate that different music synthesis software provides users with different features. The results also showed that, from user expectations point of view, Cool Edit Pro is the most preferred software. For experienced users, Csound is preferred over Cool Edit Pro. Conclusions drawn from this research finding is that different software approaches fulfil different kinds of user expectations depending on user experience.

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

PENILAIAN PERISIAN SINTESIS MUZIK SEMASA UNTUK PERLAKSANAAN PELBAGAI ALGORITMA SINTESIS MUZIK

Oleh

JULIE TAN LEE MEI

September 2000

Pengerusi: Minni Ang Kim Huai, Ph.D.

Fakulti: Ekologi Manusia

Penyelidikan ini bertujuan untuk menganalisis kegunaan perisian sintesis muzik semasa untuk perlaksanaan pelbagai algoritma sintesis muzik. Modulasi amplitud, modulasi gelang, modulasi frekuensi, sintesis penambahan dan sinthesis granula telah dilaksanakan menggunakan perisian WaveCraft [perisian antara-muka khas], Cool Edit Pro [perisian penyunting audio digital] dan Csound [perisian jenis prom arahan]. Perisian-perisian ini telah dipilih dan dikategorikan berdasarkan kepada antara-muka perisian. Walaupun Cool Edit Pro adalah perisian komersial atau penyunting editor dan bukan perisian sintesis khas, ia boleh digunakan untuk tujuan ini. Perisian muzik sintesis telah berkembang dengan begitu pesat di mana tidak ada satu definisi yang tepat mengenai ciri-ciri perisian yang boleh digunakan untuk menentukan kegunaan perisian sintesis muzik. Oleh

itu, satu jadual metrik Penilaian Perisian Muzik (PPM) dengan definisi dan kriteria tertentu telah direkacipta dan digunakan untuk menilai penggunaan perisian-perisian sintesis muzik yang digunakan di dalam projek ini. Borang soal selidik berdasarkan kepada jadual PPM telah direkacipta untuk mengumpul maklumat mengenai ciri-ciri perisian sintesis tersebut. Borang lain digubal untuk mengkaji respons pengguna dari segi kemampuan perisian sintesis; dan satu lagi borang digubal untuk menyelidik respons pengalaman pengguna terhadap perisian-perisian muzik ini. Keputusan yang diperolehi daripada kajian ini menunjukkan bahawa perisian muzik yang berlainan mempunyai ciri-ciri yang berlainan. Keputusan juga menunjukkan bahawa, daripada segi kehendak pengguna terhadap perisian-perisian sintesis muzik, Cool Edit Pro lebih dapat memenuhi keperluan yang dikenalpasti. Keputusan daripada pengguna yang berpengalaman pula menunjukkan bahawa Csound lebih disukai daripada Cool Edit Pro. Kesimpulan yang diperolehi daripada kajian ini adalah bahawa perisian yang berlainan memenuhi kehendak pengguna secara berlainan dan bergantung kepada pengalaman pengguna dalam menggunakan perisian sintesis muzik.

ACKNOWLEDGEMENTS

I wish to express gratitude to my supervisor, Dr. Minni Ang for her guidance and stimulating suggestions that enabled me to complete this thesis. Thanks also to my co-supervisors, Madam Shyamala Doraisamy and Mr. Paul R.Isitt whose commitment and constructive views assisted me in accomplishing this project. I am grateful to all of them for their help and invaluable guidance, fruitful discussions, patience and continued encouragement provided to me at every stage of this thesis.

Special thanks go to UPM for granting me the PASCA fellowship scheme, which funded me throughout my study.

Thanks also to all my friends, especially Kin Leong, Bee Suan, Yaw Feng and Yoke Fun, for their support throughout each day in UPM. Heartfelt thanks go to all Music Department staff for their hospitality and patient in providing me facilities that make it possible for me to finish the project.

Finally, I would like to express my sincere and warmest gratitude to my parents, brothers and sister for their prayers, love, and generous moral support during my study.

Thank you all and may God bless all these individuals for their kindness.

I certify that an Examination Committee met on 18th September 2000 to conduct the final examination of Julie Tan Lee Mei on her Master of Science thesis entitled "Evaluation of Current Music Synthesis Software for Rendering of Various Synthesis Algorithms" in accordance with Universiti Putra Malaysia (Higher Degree) Act 1980 and Universiti Putra Malaysia (Higher Degree) Regulation 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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Date: 10 OCT 2000

This thesis submitted to the Senate of Universiti Putra Malaysia and was accepted as fulfilment of the requirements for the degree of Master of Science.

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Date: **14 DEC 2000**

DECLARATION

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

signed

Candidate
Julie Tan Lee Mei
Date: 30/9/2000

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LIST OF ABBREVIATIONS

AM	Amplitude Modulation
ADSR	Attack/decay/sustain/release
CGI	Common Gateway Interface
CPU	Central Processing Unit
dB	Decibel
FM	Frequency Modulation
HTTP	Hypertext Transfer Protocol
Hz	Hertz
IRCAM	Institute ce Recherche et Coordination, Acoustique/Musique
kHz	Kilohertz
MIDI	Musical Instrument Digital Interface
MIT	Massachusetts Institute of Technology
PM	Physical Modeling
RAM	Random Access Memory
RM	Ring Modulation
ISO	International Standard Organisation
SIMD	Single Instruction Multiple Data
UPM	Universiti Putra Malaysia
URL	Uniform Resource Locator
VCA	Voltage Controlled Amplifier
VCF	Voltage Controlled Filter
VCO	Voltage Controlled Oscillator
WWW	World Wide Web

CHAPTER 1

INTRODUCTION

Sound synthesis is the generation of a signal that creates a desired acoustic sensation (Dodge & Jerse, 1997). According to Tan, Huang, Wong and Nguyen (1998), sound synthesis is not only confine to computer context but also has a wide and varied technology dedicated to the high quality recording and sound reproduction for the sole purpose of creating and manipulating sound. Generally any sound can be reproduced but it is only possible when a computing procedure or a synthesis algorithm is present. The sounds produced are differentiated by the parameters provided by the synthesis models where basic parameters produce basic sounds of a particular class with richer sounds requiring more well-calibrated parameters to be utilised. Similar to sound synthesis, music synthesis mimics all musical instruments using a microprocessor. Throughout the years, many music synthesis methods have been developed and used worldwide. These techniques include Additive Synthesis (Cahill, 1897; Douglas, 1968), Frequency Modulation (Chowning, 1973), Granular Synthesis (Xenakis, 1960; Roads, 1978; Truax, 1987) and Physical Modelling (Smith, 1992; Lehman, 1996). In the history of music synthesis methods, synthesis algorithms have been implemented through hardware, leading to fixed sequences of numerical operations. According to Gosnel (1997), the arrivals of Pentium and equivalent microprocessors in computers have changed the musical world. Synthesis is now starting to be more software based. This software-based synthesis will take advantage of the full capabilities of a general-purpose processor. The most important thing of software based is its capability to

move synthesis away from mathematical conception to more computational ones to perform logical tests. With this capability, controlling the synthesis will be easier to handle. These have attracted wide range of musicians who wish to create their own instruments. In addition, music software developers are also working towards producing more software according to the demand in the market. Thus, a variety of music software with different interfaces is available for users to purchase. Subsequently, users can also get freeware or shareware version of particular software through the internet. With a wide variety of software to choose from, users will usually question themselves on the quality and type of software to use. Thus, the evaluation of music software is very important in helping users to solve this problem.

The aim of this research includes the design of a quality model for comparing different types of music synthesis software. According to the International Standard Organisation 9126 (ISO 9126), there are a number of such quality models in the literature and applied in practice. The maturity of the models, terms and definitions however does not yet allow them to be included in a standard. According to Bache and Bazzana (1993), the software quality characteristics are a necessary step towards quality measurement. This has led to using the McCall *et.al* (1977) quality model as a referenced model by other researchers to develop new and better quality models. Much research has been done on the various types of quality models for comparison of different software in accordance to the software characteristics. These include McCall (1977), Boehm (1978), Perry (1987) and ISO 9126 (1993). Because research in this area is still fairly new for music synthesis