**A COMPARATIVE EVALUATION OF TONAL REPLICATION TECHNIQUES FOR MUSIC COMPOSITION AND SOUND**

**DESIGN THROUGH TONAL SYNTHESIS**

A Thesis

Presented to the

Department of Information Systems

and Computer Science

Ateneo de Manila University

In Partial Fulfillment

of the Requirements for the Degree

Bachelor of Science in Computer Science

by

Angelo Joaquin B. Alvarez

John Aidan Vincent M. Ng

Justin Carlo J. Reyes

2024ABSTRACT

This paper is a sample document that serves as a format and content guideline for undergraduate thesis submissions to the Department of Information Systems and Computer Science. In this section, the abstract, the group should be able to give the readers a clear and concise overview of their study. The section should contain the objectives of the thesis, the methods to be used, and when available, the results of the study, the conclusion, and the recommendations for further work, all based on the intended research objectives. A good abstract should be at most around 150-200 words, or half a page. It should also not contain any references, figures, or equations.

ACKNOWLEDGEMENTS

We would like to thank Dr. Ma. Mercedes Rodrigo, Dr. Ma. Regina Estuar, and Dr. Proceso Fernandez, Jr. for initiating the creation of this thesis template for use of undergraduate thesis groups for years to come. We also extend our gratitude to Ms. Jessica Sugay for her invaluable help in automating many of the formatting of this template, especially in the creation of the custom styles, table of contents, list of figures, list of tables, and the bibliography.

This section, as the name suggests, is the place in your paper where you may acknowledge individuals or groups who, with their help or guidance, made your study feasible and ultimately a reality. Some of these people include your adviser, volunteers for your study, other professors who may have contributed to your study, and if applicable, any group or organization who provided support in any way for your research.

TABLE OF CONTENTS

|  |  |
| --- | --- |
| ABSTRACT ii | |
| ACKNOWLEDGEMENTS iii | |
| LIST OF FIGURES v | |
| LIST OF TABLES vi | |
| CHAPTER | |
| I | [INTRODUCTION 1](#_Toc325760723)  [1.1 Context of the Study 1](#_Toc325760724)  [1.2 Research Objectives 2](#_Toc325760725)  [1.3 Research Questions 2](#_Toc325760726)  [1.4 Scope and Limitations 2](#_Toc325760727)  [1.5 Significance of Study 3](#_Toc325760728) |
| II | [REVIEW OF RELATED LITERATURE 4](#_Toc65001260)  [2.1 Motivation and ECAs 6](#_Toc65001261)  [2.2 New Sample Subsection 8](#_Toc65001262)  [2.3 Sample Subsection 9](#_Toc65001263)  [2.4 Sample Sample Subsection New 9](#_Toc65001264) |
| III | [METHODOLOGY 10](#_Toc65001265)  [3.1 Methodology as Replicable 10](#_Toc65001266)  [3.2 Methodology as Realistic and Time-Bound 11](#_Toc65001267)  [3.3 Summary and Additional Guide Questions 11](#_Toc65001268) |
| IV | [RESULTS 12](#_Toc353877765) |
| V | [CONCLUSION 14](#_Toc353877813) |
| BIBLIOGRAPHY 15 | |
| APPENDIX | |
| A | [INTRODUCTION AND SAMPLE GUIDE QUESTIONS 17](#_Toc353877822)  [A.1 Introduction to the Appendices 17](#_Toc353877823)  [A.2 Sample Questions for Different Studies 17](#_Toc353877824) |
| B | [THESIS FORMATTING GUIDELINES 21](#_Toc353877826) |

LIST OF FIGURES

[Figure 2.1 Expressions of Paul of M-Ecolab [10]. 6](#_Toc353877836)

[Figure 2.2 The AutoTutor Interface. [4] 7](#_Toc353877837)

LIST OF TABLES

[Table 4.1 Preliminary Test Result, organized by Problem Type 12](#_Toc65001231)

[Table A.2 Example Studies and their Guide Questions 17](#_Toc65001232)

CHAPTER I

INTRODUCTION

In this section of the paper, you want to provide the general background and motivation of your study. This can be done defining some key definitions or ideas that govern your study, presenting your context, and narrowing it down with parameters that shall concretize your study.

This chapter is divided into four parts: the Context of the Study, the Research Objective/s, the Research Questions, the Scope and Limitations, and finally, the Significance of the Study. Each will be described in greater detail in their respective sections. Appendix A summarizes major points for each of these sections and gives sample guide questions for your reference.

1.1 Context of the Study

Music is an art that evolves as musicians search for new ways to express their messages, emotions, or even their identity. Throughout music history, there has been a consistent push towards innovation whether it be by composition, sound design, or other areas of study. One such example is the musical expression of jazz, considering its relatively recent rise in the early 1900’s. In the past half century, synthesizers have led to the generation of audio signals and waveforms using additive, subtractive, or frequency modulation synthesis techniques.

The advent of synthesizers gave rise to a new era of music-making, giving birth to an array of new genres such as electronic, techno, ambient, and house music, among others. Oscillators, filters, envelopes and modulation sources came with the rise of synthesizers to empower musicians in sculpting sounds to the limits of their creative expression. Through the advancements of these features, synthesizers have broken the barriers of genres. Synthesizers have been integrated into various musical contexts, giving each genre the modern [smth].

In the past decades, the dominance of synthesizers in the music industry cannot be understated. Nevertheless, new methods of music production have come to light due to advancements in synthesizer technology and artificial intelligence. Methods such as algorithmic composition, modular synthesis, sample-based production and Machine Learning and Artificial Intelligence-assisted Composition have increased in usage over the past years.

This study aims to explore the intersection of artificial intelligence and synthesizer technology, focusing on the replication of instrumental tones through an audio synthesis from an instrumental melody. Through comparing the latest methods and techniques in the field of tone replication, this study aims to contribute to our understanding of how synthesizers can further shape the landscape of music composition and sound-design in the coming years.

1.2 Research Objectives

The study aims to utilize various techniques in audio synthesis and replication, namely Tone Transfer, GANs (Generative Adversarial Networks), and DSPGAN in order to replicate instrumental tones, comparing them in terms of accuracy and efficiency. The sub-objectives are as follows:

* To determine how the quality and choice of input audio encoding and representation affect sound replication efficiency and accuracy,
* To determine the stability of the outlined methods in handling various factors in the audio input, such as noise, frequency masks, low audio quality, and fragmented audio inputs,
* To determine the perceptual quality of synthesized audio as compared to the original audio input, and
* To determine the effect of contrasting feature selection and representation on the accuracy and efficiency of synthesized audio.

1.3 Research Questions

The study seeks to answer the question: How do methods in audio synthesis and replication such as Tone Transfer, GANs, and DSPGAN compare in their accuracy and efficiency in replicating instrumental tones? In answering this question, the following sub-questions can be answered:

* How does the quality and the choice of encoding and representation for the input audio impact the efficiency and accuracy of sound replication?
* How stable are different methods in audio synthesis and replication in handling noise and frequency masks in the audio input, low audio quality, and fragmented audio inputs?
* How does the synthesized output generated by the model compare to the original audio input in terms of perceptual quality?
* How do the contrasting feature selection and representation employed in different methods contribute to their accuracy and efficiency in replicating instrumental tones?

1.4 Scope and Limitations

In order for your study to be realistic, doable, and still produce a concise answer to your research questions within a particular period of time, this section provides you the opportunity to both cross-out extraneous variables, as well as set those aspects that must be controlled in your study. Some common limitation targets include the target audience for the experiment, the software to be used, portability and reusability of the software, the features it will have, and so on.

1.5 Significance of Study

If the Research Objective answers the ‘what’ of your study, this section aims to answer the ‘why’. Generally, you may address this significance in terms of its significance in the area of Computer Science and the community. However, other questions which you may also use to guide your significance are the following: “Why is your study important?” “What will your study contribute to the field of Computer Science?” “How will your study benefit not only your intended audience, but the general public, especially our country?”

CHAPTER II

REVIEW OF RELATED LITERATURE

Now that you have established what your study is, this section provides you the ability to look into your research area in order to find out what is the state-of-the-art regarding your topic of interest. By the end of this section, you should already have an idea of what has been done in relation to your work, what findings they had about their studies, and how your own study factors into what was observed (e.g. improvements based upon the studies’ recommendations, techniques that can be borrowed, delineating where previous work ends and where your study begins).

Although it discusses a variety of literature, it is still important to maintain a general flow within your discussion. Make use of transitions and other literary means to connect the ideas of each discussed article. One way to do this is to first organize your articles into general topics of discussion. You may then introduce the flow of these topics in the first few paragraphs of this section, and use the topic outline you created as your guide in delivering, comparing and contrasting what ideas you may wish to present about the literature. You can also use the themes as your sub headings. Finally, summarize your literature review by briefly going through the key ideas of previous work, identify points for improvement, and state what your study can do to contribute in addressing those points.

Last but not the least, do not forget to put proper citations to the ideas you will present. More often than not, whatever idea you state here came from another source, so ensure that you acknowledge the article/book/other reference you may have lifted it from.

In order to guide you in writing, as well as to summarize the points mentioned above, here are some questions that may help your structure your discussion:

1. What previous works are closely connected with your own study? Who initiated these studies?
2. What objectives did these studies have? If they presented any research questions, what were these and how similar or different are they from your own set of questions?
3. Describe the methods used in these studies.
   1. If there are test subjects, what is the general profile of their subjects?
   2. What instruments did they use to acquire and measure their data?
4. What were the findings gathered from the studies?
5. What issues, if any (e.g. flaws or gaps in the methodology), were encountered during the implementation of the study? In what way did the researchers attempt to address these issues? Were they successful in resolving these issues? Why or why not?
6. What conclusions did these studies have? What recommendations did they present, and which of these recommendations may be addressed through your study?
7. What other improvements could be done that was not mentioned in the study? How will your study incorporate these improvements?
8. In what way is your study different or novel given these previous studies? Where do their studies end, and where will yours begin?

Below is a sample entry from a literature review. You may use this as basis for your own work.

2.1 Previous Methods for Audio Synthesis

2.1.1 WaveNet and GANs (Generative Adversarial Networks)

The use of WaveNet autoencoders for neural audio synthesis, one of the recent technological advancements regarding audio synthesis of the past decade, paved the way for computational musicology by using conditional autoencoders learned from raw audio waveforms. One of its contributions is also the NSynth dataset, a “large-scale dataset for exploring neural audio synthesis of musical notes.” which was composed of over 300,000 notes belonging to instruments of different families (strings, vocals, wind instruments, etc.). It was found in their study that playing styles such as vibrato could be replicated looking at instantaneous frequencies in a spectrogram, and harmonic structures and overtones blended more smoothly. While revolutionary, it was only able to recreate sample-based audio, and was not able to capture fully global context. Engel et al. (2017)’s paper showed that creating sample-by-sample audio signals was possible through the use of deep learning.

Instead of using vocoders, frequency modulation, MIDI synthesizers, or any combination of the three and other possible methods, deep learning for audio synthesis is headed toward directly replicating the waveform of audio samples. GANSynth, a study conducted by Engel et al. (2019) uses a Progressive GAN architecture combined with conditioning of an additional feature: a one-hot representation of musical pitch. GANSynth uses Short Time Fourier Transforms (STFT) and IF-Mel (log magnitudes and mel frequency scales) variants in order to generate samples that are over 50,000x faster than those generated by WaveNet. Aside from faster sample-generation, GANSynth utilizes information from the latent features and musical pitch of the training dataset to generate audio exhibiting smooth timbral interpolation and timbral consistency across different pitches. The introduction of GANSynth marks a significant development in the use of GANs for audio generation, synthesizing audio with superior quality when compared to the previous WaveNet autoencoder.

In applying motivational concepts to ECAs, some previous work includes studies by Rebolledo-Mendez et al. [9] and Graesser et al [4], [5].

Rebolledo-Mendez et al. [9] investigated the effect of a motivational version of Ecolab, an ITS for teaching primary school children the topic of Ecology, particularly about food chains and food webs. In implementing the motivational extension, they modeled three motivational traits identified as key in the learning context. These are effort, confidence, and independence from the tutor [9]. The motivational on-screen character, which they named as Paul, was designed to provide feedback before and after each activity. Each post-activity feedback was based on the motivational model of the learner, and using this, Paul encourages the learner: to exert more effort, to be more independent, or to become more confident [9].

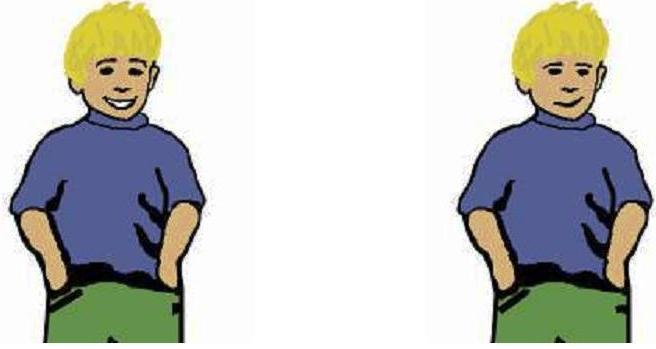


Figure 2.1 Expressions of Paul of M-Ecolab [10].

The results of the study showed that through modeling motivation and adjusting motivational reaction, the de-motivated, low, and average students were able to significantly increase their post-test scores. It also, however, showed that highly motivated and high ability students had no increase in test scores. The researchers noted that this could be due to the “ceiling effect”. Nevertheless, it was highlighted that the effects on learning by these motivating techniques were different, depending on the students’ ability and motivation. An example would be adjusting spoken feedback considering the learners’ motivational state as an important influence at post-activity time [9].

There were, however, some limitations to the study. One of these was that the results were derived from a very small sample. Another limitation they indicated was that adapting feedback and character’s reactions, in conjunction with a quiz, constitute only a first step in the study of motivating techniques in ITSs; thus, general guidelines could be used in order to improve student motivation [9].

On the other hand, Graesser et al. [4] developed a computer tutor called AutoTutor, which simulated the discourse patterns and pedagogical strategies of a typical human tutor. It was designed for college students in introductory computer literacy courses, who learn the fundamentals of hardware, operating systems, and the Internet [4].

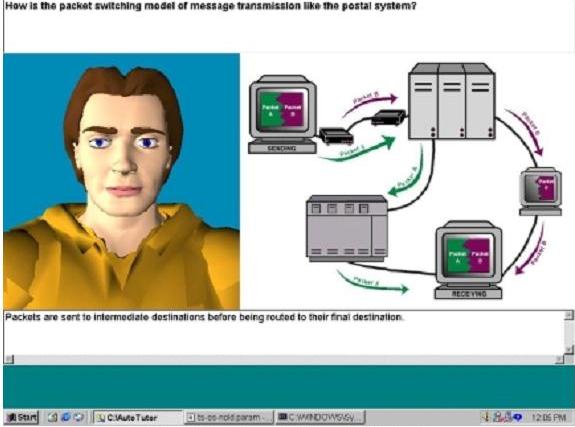


Figure 2.2 The AutoTutor Interface. [4]

AutoTutor works by initiating a conversation with the student. It appears as a talking head that acts as a dialogue partner with the learner, who contributes to the conversation via input from the keyboard. One thing notable about the tutor is that it encourages the learner to articulate answers that are lengthy and require deep reasoning – examples of which include answers to why, how, and what-if questions. There is a multi-turn dialogue involved between AutoTutor and the student, encouraging the student to construct the knowledge and discover what he or she has mastered, rather than bombarding the student with the information to master [4].

Results of the study show that this strategy of AutoTutor was able to influence learning and mastery of students. Comparing students who used AutoTutor to those who only reread the topic and to the control group who did not reread, AutoTutor was able to help students answer more questions which were used in an actual computer literacy course, garnering a greater score than the two other groups [4].

In terms of the conversational smoothness and pedagogical quality of dialogue, an experiment was done where students were asked to point out which dialogue moves were generated by human tutors and which ones were by AutoTutor. Results show that the students were unable to discriminate the dialogue moves that were computer-generated compared to those from human tutors. In reality, half of the dialogue was by human tutors and the other half by AutoTutor. This proved the ability of AutoTutor to accurately simulate a human tutor [4].

In a related study, Graesser et al. [5] was able to determine that during interactions with the AutoTutor, confusion was a great predictor of post-test scores. The study showed that when the learner is confused the learner experiences cognitive disequilibrium and thinking. It is presumed that the other frequent emotions such as frustration, bored and flow play a more prominent role in other learning environments and population of learners. It is therefore suggested that further research be conducted on these frequent emotions to discover different strategies and dialogues that will promote both learning gains and more engagement for the students [5].

2.2 New Sample Subsection

This is added in between existing subsections.

2.3 Sample Subsection

Blah blah blah blah!

2.4 Sample Sample Subsection New

This is added after the last existing subsection. Updated the TOC, it works.

CHAPTER III

METHODOLOGY

After introducing your topic of choice, discussing and relating previous work with your own, and presenting the underlying concepts that your study will be working with, this section will enable you to go into fine detail into how you will go about your study. Essentially, whatever data you need to gather, as well as how you will intend to gather them, should be presented here.

In order to check whether or not your methodology is sound, two main questions should be answered:

1. Is your methodology replicable?
2. Is your methodology realistic and time-bound?

3.1 Methodology as Replicable

A replicable methodology basically means that anyone who reads your methodology and intends to recreate your study to the letter must be able to obtain a similar, if not, exactly the same set of results. It is important, therefore, that you be as specific as you can when describing your methods, such as properly delineating your study’s independent, dependent, and control variables. Much like in the literature review and framework, it is good practice to organize your methodology into subsections for easier readability. Of course, apart from generating data given these variables, included in making the methodology replicable is providing the users an effective and appropriate means to collect data for analysis later on. This assumes, of course, that the data you intend to collect is actually measurable, whether it be quantitative (numerical) or qualitative (descriptive).

3.2 Methodology as Realistic and Time-Bound

On the other hand, a realistic and time-bound methodology takes into consideration the context of the researcher. Although a high-level of competency is expected from a graduating CS major, one must also ensure that the proposed study’s level of difficulty is aligned with what limited resources is available, especially time. In fact, given that the trend is that you will undergo actual implementation only after being able to defend your proposal during the first semester, the study should be accomplishable at the most within only a semester. It is therefore imperative in the methodology, especially in its initial presentation during the defense, that the timetable for the study is thoroughly laid out, with workable time frames and specific dates for deliverables.

3.3 Summary and Additional Guide Questions

The methodology, in summary, is your detailed explanation of how you intend to go about implementing your study.

CHAPTER IV

RESULTS

After implementing your methodology and gathering all pertinent data, in this section, you will now present the gathered data to your reader. By the end of this section, your reader should have an idea of what exactlty happened during the experiment.

A good way to organize your results is to group them is to present them in the same order which your methodology was presented. For instance, if your methodology included the analysis of user logs, the implementation of an application, and the testing of this application, your results should flow in the same way. In addition, more often than not, you will be presenting a large volume of data, so utilize figures and tables whenever appropriate. Table 4.1 below presents one way of how to go about presenting your data. Note the table caption and headers, as mentioned in our framework.

Table 4.1 Preliminary Test Result, organized by Problem Type

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Problem Type | Average Steps | Standard Deviation (Steps) | Average Duration (s) | Standard Deviation (Duration) | Dominant Affective State |
| A1 | 14 | 2.3 | 23.04 | 3.5 | CONF |
| A2 | 2 | 5.36 | 32.10 | 2.01 | FLOW |
| A3 | 31 | 1.01 | 28.55 | 4.03 | FLOW |
| B1 | 24 | 4.4 | 45.30 | 3.3 | BOR |
| B2 | 33 | 2.12 | 20.56 | 2.21 | FLOW |
| B3 | 36 | 1.05 | LOSE | 1.15 | CONF |
| C1 | 22 | 1.33 | LOSE | 1.4 | FLOW |
| C2 | 23 | 3.032 | LOSE | 1.3 | FLOW |
| D1 | 30 | 1.79 | LOSE | 1.45 | FLOW |
| E1 | 15 | 1.3 | LOSE | 1.05 | FLOW |

There are, however, some additional notes that must be clarified. First, given that you will be gathering a huge volume of data, you must be able to classify which of these were critical in determining the outcome of your study, and which ones need not be presented. The critical data must be presented in this section, while the minor ones may be placed in the Appendices of your paper, which will be described later in this template.

Another clarification to be noted is that the presentation of results in this section must be objective, or ‘as-is’. This means that you must describe your results in a way understandable to your reader without putting any form of interpretation. In effect, this section’s intent is to provide answers to “what happened” questions, not “what does it mean” questions. The interpretation of results is the subject of a later section.

Finally, because this is a presentation of what happened in the past, all tenses used in this section must be in the past form, be it active or passive. This will also be true for the preceeding sections after the study’s implementation, especially when stating the methodology.

CHAPTER V

CONCLUSION

Upon presenting your results, the conclusion is where you will now tie up these results with the original intent of the study, as indicated by the research questions given in the Introduction. It is in this section where you will also discuss any difficulties or issues encountered during the study, as well as your recommended method for addressing these problems.

The general way to organize your conclusion is to present each research sub-question as a subsection, and thoroughly answer each of them by interpreting your results with respect to the question. With these answered, you may then tie up all of your findings in each subsection to answer your main research question, providing any needed additional information or explanation. Last on the list would be your unsolved issues and difficulties, presenting them as avenues to motivate continued work on your chosen topic.

BIBLIOGRAPHY

1. Andallaza, T.C., and Jimenez, R.J. 2012. Design of an Affective Agent for Aplusix. Undergraduate thesis, Ateneo de Manila University.
2. Bate, A.E.C. 2010. Automatic detection of student off-task behavior while using an intelligent tutor for algebra. Masteral thesis, Ateneo de Manila University.
3. Csikszentmilhalyi, M. 1990. Flow: The psychology of optimal experience. Harper & Row New York.
4. Graesser, A., Chipman, P., King, B., McDaniel, B., and D’Mello, S. 2007. Emotions and learning with autotutor. Proceedings of the 2007 conference on Artificial Intelligence in Education: Building Technology Rich Learning Contexts That Work (2007), 569-571.
5. Graesser, A., Person, N., Harter, D., and The Tutoring Research Group. 2001. Teaching tactics and dialog in autotutor. International Journal of Artificial Intelligence in Education 12, 3 (2001), 257-279.
6. Harr, R., Wilberg, M., and Whittaker, S. 2011. Understanding Interaction Search Behavior in Professional Social Networks. Human Technology 7, 3 (2011), 194-215. URL=http://www.humantechnology.jyu.fi/articles/volume7/2011/Harr-Wiberg-Whittaker.pdf.
7. Lagud, M.C.V. 2010. The affective and learning profiles of students while using an intelligent tutoring system for algebra. Masteral thesis, Ateneo de Manila University.
8. Lim, S.A.L. 2010. Towards a framework for developing motivational agents in intelligent tutoring systems. Masteral thesis, Ateneo de Manila University.
9. Rebolledo-Mendez, G., du Boulay, B., and Luckin, R. 2006. Motivating the learner: An empirical evaluation. Intelligent Tutoring Systems (2006), 545-554.
10. Rodrigo, M.M.T., Rebolledo-Mendez, G., Baker, R., du Boulay, B., Sugay, J., Lim, S., Espejo-Lahoz, M.B., Luckin, R. 2008. The effects of motivational modeling on affect in an intelligent tutoring system. International Conference on Computers in Education 2008, (2008) 49-56.

APPENDIX A

INTRODUCTION AND SAMPLE GUIDE QUESTIONS

A.1 Introduction to the Appendices

The Appendices are where you are enabled to present any additional or supplementary information relevant to your study, yet do not require highlighting within the actual paper, either because of its trivial nature or volume. These may in the form of figures, tables, or additional text detailing specific aspects about or related to the study.

A.2 Sample Questions for Different Studies

The following table presents three sample studies, as well as the guide questions that may help direct the discussion in each section of the paper. You may use this as another reference in writing your paper.

Table A.2 Example Studies and their Guide Questions

|  |  |  |  |
| --- | --- | --- | --- |
| Section | Example A: A Mobile application that gives the cheapest public transportation route from Point A to Point B | Example B: Development of a first-person shooter game | Example C: Development of a machine-learned model of student carelessness while using software for algebra |
| Introduction | How many people commute every day?  What is so hard about commuting?  How much time/money do people spend in commuting?  What is the core service that your app will provide?  Why is this important / valuable / helpful?  What is the target platform of your app?  What are the key design considerations?  How will you determine whether the app is able / not able to provide the intended service?  Example of a goal:  Our goal is to create a mobile application that will give commuters the cheapest public transportation route from any point to any other point within Metro Manila.  Examples of research questions:  1. How can we best represent the database of transportation routes in Metro Manila?  2. How can the routes be made accessible through a mobile app?  3. How can we compute the cheapest route from any given point A to point B?  4. How do we measure the accuracy of the route? | What is a game?  What is a first-person shooter game?  What are games for?  How large is the game industry in the world? In the Philippines?  Does the industry have any large-scale economic impact?  What is the overall plot of your game?  What is the intended platform of your game?  What are the important / unique / unusual characteristics of your game—should it be fun? Scary? Exciting? Affect sensitive? Based on Phil mythology? Gesture-based?  How will you measure whether your game is “good”?  Example of a goal: Our goal is to develop a first-person shooter game using the Kinect.  Examples of research questions:  1. How can we read gesture-based input from the Kinect?  2. What is an acceptable plot for a first-person shooter game?  3. What game assets should be developed to make the game engaging / fun / scary / etc.  4. What user experience are we trying to create and how do we measure whether users indeed have this experience? | What is student carelessness?  Why is an important topic in learning?  What is the effect of carelessness on achievement? On the estimation of student learning? On the effectiveness of instruction?  In broad terms, what input data will be used to create the model?  Where will the data come from – from what students, what schools, what software?  In broad terms, what techniques will be used to arrive at the model?  How will you determine model “goodness”?  Example of a goal: Our goal is to build a machine learned model of student carelessness.  Examples of research questions:  1. What are the features that might be indicative of student carelessness?  2. What machine learning algorithms are most appropriate for the data set?  3. How can we determine the model’s goodness of fit?  4. What are the model’s implications on learning? |
| Review of Related Literature | What is considered to be the state of the art in mobile apps? In transportation information systems?  What available software apps already provide commuting information? For what platforms? For what cities?  What are the strengths / weaknesses of these apps?  Are there any apps specifically for Metro Manila?  Who made them?  For what platforms?  What were their limitations?  How is your work similar? Different? What do you add that is new / innovative? | What is considered to be the state of the art in games?  What is a first-person shooter game? Give examples of first-person shooter games. What are the games’ plot, controls, platform?  What is considered to be the state of the art in first-person shooter games? What makes them “state of the art”?  Describe the games for the Kinect? What is innovative or different about the games for the Kinect?  Assuming the goal of the project is to make a game that is scary, why is fear supposed to be a desirable emotion to evoke in players? Says who? How does fear improve / enhance the gaming experience?  How is your game going to be similar / different from the games you have reviewed? What will you add to the game that will make it different / similar to previous games? What will make your game innovative? | How has carelessness been studied in the traditional classroom? What were the findings? What are the effects of carelessness on learning / assessment?  What is educational software?  How have researchers used educational software to study student learning or learning behaviors or emotions?  How has educational software been used to study carelessness specifically? What were the research questions? How were the studies been conducted? What were the findings?  What are you borrowing from previous studies? What gaps are you addressing? |
| Theoretical Framework | What are graphs? How are they represented? What are the ways in which we compute for minimum cost in a graph? What are the applications of graph theory and minimum cost calculation?  What are the characteristics of software development for mobile platforms? What are the limitations of platform? | What is a game?  How are games classified? Zero in on the classification that you are addressing and discuss the distinguishing features of this classification, e.g. what makes a first-person shooter game different from a card game or a board game or a word game?  What are the design considerations that make a good fps game?  What are gesture-based interfaces? How are gestures read? How are they interpreted? | What is carelessness? Ho w is it related to learning?  What is educational software?  What are the characteristics of educational software that enable researchers to use these as platforms for studying educational phenomena?  What is educational data mining? What are examples of educational data mining techniques? |
| Methodology | Describe the intended users in terms of age, educational background, IT literacy.  How will you represent the graph – Describe the database, the attributes, the relationships between tables.  What graph algorithm will you will use?  What software engineering approach that you will use?  How will you test your software? How will you gather data from test subjects (if at all)? Is there a survey you will use? If so, you will have to include a draft in the proposal. | Describe the intended users.  Describe the game plot.  Describe (include samples of) the art assets of the game.  What game engine or language will you use to develop the game?  What software engineering methods will you use?  Describe how you will interface between the Kinect and your software.  How will you test the game—how many users? How long will they play the game?  How will you measure the user experience? Include any survey instruments or questionnaires that you might use. | Describe the target user group.  Describe the learning platform. Include screen shots  Describe each feature of the data set.  Describe the data mining methods that you will use.  How will you validate your model? |

APPENDIX B

THESIS FORMATTING GUIDELINES

This thesis template in Word document format was created to ensure that you will spend more time generating content for your paper and less time stressing about formatting issues. To ensure, however, that your document is truly formatted according to specifications, here are some formatting guidelines which you may use to evaluate your own paper’s formatting.

1. There should be NO PAGE NUMBERS on the first page of every chapter/section.
2. Tables must have NO VERTICAL LINES, as well as NO INNER HORIZONTAL LINES after the table headers.
3. Figures and tables are numbered ACCORDING TO CHAPTER NUMBER (e.g. Table 3.1 must be located in Chapter 3, and Figure B.2 is in Appendix B).
4. The sequence of front matter must be as follows:
   1. Title Page, in the correct formatting (e.g. Titles must be written in an inverted triangle, in ALL CAPS and boldface)
   2. Abstract
   3. Table of Contents
   4. List of Figures
   5. List of Tables
5. Upon binding, the front cover must contain the EXACT CONTENT AND FORMAT as that of your thesis’ title page.