**Chapter 2: Research Design**

Primary Data

Problem Identification and Clarification

Research Objectives

* Problem Identification: Transformer models have shown great promise in generating polyphonic music, but it is unclear how well they can capture long-term dependencies in the music.

Problem Clarification: The ability to capture long-term dependencies is important in generating music that has a coherent structure and is musically pleasing.

Problem Formulation: How effective are self-attention mechanisms in transformer models for capturing long-term dependencies in polyphonic music?

Objective: To evaluate the effectiveness of self-attention mechanisms in transformer models for capturing long-term dependencies in polyphonic music.

* This objective aims to investigate the suitability of transformer models for music generation by evaluating their ability to capture long-term dependencies in polyphonic music. The objective will involve examining the effectiveness of self-attention mechanisms in identifying and encoding relationships between musical elements over longer time periods.
* Problem Identification: The impact of training data on the performance of attention-based transformer models for polyphonic music generation is not well understood.

Problem Clarification: It is unclear how the size and diversity of training data affect the quality of generated music by attention-based transformer models.

Problem Formulation: The objective is to evaluate the impact of training data on the performance of attention-based transformer models for polyphonic music generation, and how the size and diversity of training data affects the quality of generated music.

Objective: To determine the relationship between training data size and diversity, and the quality of generated music by attention-based transformer models for polyphonic music generation.

* The objective of this study is to investigate how the quality of generated music by attention-based transformer models for polyphonic music generation is affected by the size and diversity of the training data used to train these models. In other words, the study aims to determine whether the quantity and variety of the training data have an impact on the quality of the generated music. By evaluating this relationship, the study can provide insights into how to optimize the training data selection process to improve the performance of attention-based transformer models for polyphonic music generation.
* Problem Identification: Computer-generated music often suffers from repetitive patterns, which can make the music uninteresting and predictable.

Problem Clarification: Generating diverse and original music is important in creating music that is musically pleasing and engaging.

Problem Formulation: How well can attention-based transformer models generate diverse and original polyphonic music, and how effective are they at avoiding repetitive patterns and generating novel musical ideas?

Objective: To assess the ability of attention-based transformer models to generate diverse and original polyphonic music by examining their ability to avoid repetitive patterns and generate novel musical ideas.

* The objective of this research is to evaluate the diversity and originality of polyphonic music generated by attention-based transformer models. Specifically, the research aims to examine the model's ability to avoid repetitive patterns and generate novel musical ideas. By assessing the model's ability to generate diverse and original music, this research can contribute to the development of more advanced and creative machine learning models for music generation.

Validity Type

The two components of validity management are relevant and reliable.

Relevant: The thesis aims to evaluate and justify the use of attention-based transformer models for polyphonic music generation. Previously, neural networks were used with limited success due to the exploding gradient problem. However, since the introduction of Large Language Models, it is deemed relevant to view music generation as a language modeling task and to apply attention-based transformers to this domain. The study will assess the relevance of utilizing these models in the context of music generation and evaluate their performance.

Reliable: The thesis will assess the effectiveness of attention-based transformer models for capturing long-term dependencies in music. The reliability of the findings will depend on the robustness of the evaluation methodology and the validity of the results.

Ethical and Legal Considerations

Primary Research

Ethical considerations were central to the Data Analysis project. Voluntary participation and informed consent from all five participating experts were required for the primary research. This was achieved by providing a clear explanation of the study's purpose, the nature of their involvement, and the utilization of their data via email/Linked In message. The option to seek clarification or pose questions beforehand through the same email chain was encouraged, with full respect for their decision to participate or withdraw from the study at any stage.

Trust and respect were of the utmost importance for all participants in the study. This meant showing up to the meeting early and being prepared to start with plenty of questions to fill the time slot agreed upon. Maintaining professionalism throughout the interview and ensuring their opinions and expertise were valued.

Ensuring the accuracy of result reporting is paramount. This process entails transcribing the recordings verbatim and extracting vital themes, quotes, and interesting insights while avoiding the inclusion of redundant or fabricated information.

When composing the thesis results, confidentiality and anonymity of the experts' responses will be maintained by assigning each of them an alias (e.g., interviewee A). All other personal information, including names, email addresses, Linked In profiles, phone numbers, etc., will be securely stored in private Linked In and/or email accounts with password protection and in a password-protected folder on a personal laptop. The findings will be presented in a manner that honours the experts' contributions and upholds the research's integrity. Themes and insights derived from all five interviews will be summarized, enhancing readability, and preserving the essence of each interviewee's input.

In conclusion, ethical principles take precedence in the thesis project. Voluntary participation and informed consent are essential, ensuring that all five experts involved in the interviews comprehend the study's purpose, their roles, and the utilization of their data. Trust and respect play a central role, emphasized through punctuality, preparedness, and genuine appreciation for the experts' opinions and expertise. Reporting and dissemination follow responsible practices, accurately conveying the results of data analysis through verbatim transcriptions and the extraction of key themes, quotes, and insights. To protect confidentiality and anonymity, experts receive aliases, and personal information is securely stored. Ultimately, the findings are presented in a format that honours the experts' contributions, delivering summarized themes and insights that preserve the research's integrity and engage readers effectively. These ethical considerations ensure a robust and respectful execution of the Primary Research in the thesis project.

Secondary Research

In the ever-evolving landscape of AI-generated music, a fundamental consideration lies in its harmonious coexistence with established copyrights and the avoidance of infringement. The Irish, UK, and USA copy right laws state ‘copyright in a literary, dramatic, musical, or artistic work expires 70 years after the death of the author, after which the work is said to enter the public domain. This means that work may then be used or modified or republished by any person, without fear of copyright infringement.’(*About Copyright*, no date), (*How copyright protects your work*, no date), (Editor, 2022) This, in essence, emancipates the creation, allowing it to be freely utilized, adapted, and republished without the looming spectre of copyright infringement. As we venture into the realms of AI-driven musical composition, it becomes pivotal to not only respect these legal frameworks but also to leverage open-source data, discussed in the Data Collection section, that not only aligns with copyright regulations but also duly acknowledges the sources, thereby safeguarding intellectual property and artistic integrity.

When venturing into the realm of AI-generated music, it's crucial to remain vigilant about potential biases stemming from the training data and algorithms, which may result in the production of prejudiced or objectionable musical compositions. The landscape of music genres and their associated music theory is far from straightforward. Their development is influenced by a complex web of factors, often intersecting, and shaping the transformation of musical styles and practices. Music is profoundly shaped by elements such as geography, culture, religion, historical events, technological advancements, demographics, as well as the blending and fusion of various influences, to name just a few.

Critical aspects to be mindful of in the model's output is the potential presence of stereotypes and cultural biases in the music it generates. Stereotypes can emerge when the AI model, intentionally or unintentionally, replicates simplistic or biased notions about certain musical styles, genres, or cultures. For example, the model might falsely associate specific musical elements with cultural clichés, resulting in misrepresentations. These stereotypes can perpetuate cultural insensitivity and lead to feelings of hurt or disrespect among listeners.

Furthermore, cultural biases may also influence the AI-generated music, as they can manifest in the model's interpretation of various musical traditions and practices. Biased training data or human annotations may inadvertently introduce cultural biases into the system, leading to music that fails to authentically represent the rich diversity of musical heritage.

To mitigate these issues, it was imperative to choose the training dataset with meticulous care and a deep understanding of this nuanced reality. This involved not only diversifying the training data but also rigorously scrutinizing it for any pre-existing stereotypes and cultural biases. By doing so, we ensured that AI-generated music respected the rich tapestry of human culture and history while fostering creativity and innovation.

The most beautifully composed music possesses a unique quality that transcends mere ear-pleasing delight, it has the power to stir deep emotions within us. These emotions can be both positive and negative. With this in mind, we recognize the responsibility that comes with creating and sharing music. This responsibility extends to the well-being of our audience, and we have taken steps to ensure that our creations do not inadvertently cause discomfort or harm. By seeking feedback from a diverse group of listeners and making necessary adjustments, we endeavour to craft music that touches hearts and minds without causing unintended distress. In this intricate dance between AI and art, we strive to create music that resonates with people while respecting legal and cultural boundaries, ultimately offering a harmonious and inclusive musical journey.

Within the ever-shifting domain of AI-generated music, the harmonious coexistence with copyright laws, vigilant avoidance of biases, and the creation of emotionally resonant compositions represent the pillars upon which the future of this art form stands. Navigating the intricate landscape of musical creation, we must remain steadfast in our commitment to legal and ethical principles, while also embracing the boundless possibilities that AI offers for creative expression. By upholding the values of respect, diversity, and emotional connection, we ensure that AI-generated music not only honours the past but also paves the way for a harmonious and inclusive musical future. In this intricate fusion of technology and art, we find a symphony of potential, where AI and human creativity join hands to compose a harmonious melody for generations to come.