

Generative AI Microfrontend Chatbot Development

(Technical Paper)

The Impact of AI-Generated Music on Human Creativity in the Music Industry

(STS Paper)

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

Music has always been a reflection of human culture, evolving alongside advances in technology and society. From the earliest recovered Gregorian chants to the advent of recorded music in the 20th century, each technological shift in history has expanded music's reach across generations. In the most recent years, advancements in artificial intelligence technology have increasingly transformed the music industry. AI-generated music platforms have introduced a new era where compositions can be created in seconds based on simple text prompts. Compared to the years of training and creative dedication that musicians and composers invest in, generative AI can dramatically shorten the production time of music, which calls into question the value of human expertise in a field increasingly influenced by automation. As a classically trained pianist with 16 years of experience, I can understand the rigor and passion required to bring musical compositions to life.

While generative AI offers new and accessible tools for artists to produce music, it simultaneously poses a significant threat to traditional career paths in music. Composers and producers, whose livelihoods depend on their ability to create music, face growing competition from generative AI algorithms that can easily replicate stylistic nuances and perform intricate tasks such as mixing and mastering. For example, platforms such as Google's MusicLM create melodies based on a specific text, and Landr is a music production software that provides automated mastering services. With the popularity of programs like these, the need for composers and producers would be further displaced. Though live concert performances retain a unique human touch that generative AI struggles to replicate, the potential of AI-generated music is rapidly expanding to areas that were once the exclusive domain of trained professionals.

These developments pose the question: How does AI-generated music in commercial production affect human composers, musicians, and music producers? While AI-based tools enable new, accessible methods of music production, they also risk devaluing the human expertise that distinguishes musical art forms. As companies increasingly integrate these tools, composers and music producers, in particular, face the possibility of diminished career opportunities. As a summer 2024 intern at General Dynamics Mission Systems, I worked on the development of a generative AI chatbot to improve the productivity levels of employees. Both AI-generated music and chatbots exemplify the dual nature of AI and its potential to enhance efficiency while raising questions about the societal impacts on labor. Exploring these effects will offer insights into how AI can come to coexist within our industry rather than replace human labor.

Ultimately, the goal of this paper is to propose two projects that explore the intersection of AI technology and human labor. The technical project focuses on the development of a generative AI microfrontend chatbot that aims to streamline tasks and enhance productivity within business environments. The STS research project will investigate the broader societal and ethical implications of AI-generated music on human labor in the music industry. By conducting a discourse analysis of industry narratives, the project will examine how AI affects the careers of composers, musicians, and producers. Together, these two projects provide insights into how AI can both complement and challenge human expertise, with a focus on preserving the value of human creativity and skill in industries affected by automation.

Technical Project

The generative AI microfrontend chatbot we developed at General Dynamics Mission Systems (GDMS) is an internal productivity tool designed to address the needs of employees

while safeguarding sensitive data. This custom-built chatbot offers GDMS a secure alternative to popular generative AI platforms like ChatGPT or Copilot, which are unsuitable for government contractors due to data privacy concerns. Built using Python for backend processing and Angular for the frontend, the chatbot operates on GDMS's internal network, ensuring that no external access to data occurs. This security measure was essential, given the company's work with confidential information.

The chatbot was designed to streamline routine tasks, such as report generation, basic troubleshooting, and even administrative activities like scheduling meetings and drafting emails. By integrating into the company's main Hub page, it becomes readily accessible to employees across various departments. The tool's flexibility in using different AI models based on the specific task at hand allows it to provide tailored responses, from technical problem-solving to creative writing support. This adaptability enhances its functionality across multiple workflows, making it valuable for diverse teams within GDMS.

Early tests in the IT and engineering departments have shown significant reductions in time spent on repetitive tasks, with employees reporting up to 50% time savings. Potential benefits include further reductions in time spent on routine activities and increased overall productivity, potentially impacting work-life balance by freeing up time for employees to focus on more strategic projects. However, the tool also raises concerns about dependency on AI for routine tasks and the possible gradual reduction of traditional roles. Employees may also become less inclined to solve problems independently or develop troubleshooting skills, which will reduce the skill levels of workers over time. In addition, there are also risks of data privacy and security issues in the case of an internal data leak. Chatbots handle sensitive data, especially in secure environments like government contractors, so data could be exposed if not properly

secured. Careful monitoring will be needed to ensure that the chatbot serves as a supportive resource without diminishing human expertise. In addition, I have written a technical report reflecting on this internship experience, which covers the development process, challenges encountered, and the future designs of the generative AI microfrontend chatbot.

STS Project

AI-generated music in commercial production significantly impacts the industry for human composers, musicians, and music producers, raising questions about creativity, employment, and emotional expression. AI's potential to automate aspects of music production and composition can streamline workflows and offer accessibility, but it also presents challenges of potentially reducing the value of human expertise. The historical context of AI in music demonstrates the steady growth of automated systems in composition and performance (Roads, 1980). Early rule-based systems and heuristic programming laid the framework for the more complex models of today, which can replicate the compositional processes that traditionally required years of professional training. AI-driven music tools like MusicLM by Google represent the advancements that enable rapid and complex music creation with limited human intervention. AI-based affective music generation (AI-AMG) systems can evoke specific emotions in listeners, demonstrating that these tools can mimic not only the technical aspects of music composition but also the emotional tone that often distinguishes a skilled human composer (Dash and Agres, 2024). However, AI-AMG systems often face limitations in fully capturing the nuances of human expressiveness. This gap between AI and human emotion poses a barrier to completely reducing human labor since they have a unique role in conveying emotional subtleties in music.

For musicians, the performance aspect provides a relatively more stable area of the industry, particularly as live concert experiences remain central to music culture. While AI can

simulate certain performance characteristics, there are arguments that AI struggles to capture the spontaneity and expressiveness that define live music (Lopez de Mantaras and Arcos 2002). AI systems like the SAXEX model can imitate human-like expressiveness to a degree but still fall short of replicating the full spectrum of emotional depth found in a live performer. Musicians, particularly those in genres where live performance is imperative, retain their roles as irreplaceable performers since AI-generated music lacks the tangible connection between artist and audience. This irreplaceable connection between the artist and audience emphasizes the continued importance of human performers, particularly in genres where live concerts are crucial.

Producers face a more complex relationship with generative AI. Platforms like Landr offer automated mastering services that eliminate the need for skilled sound engineers in certain contexts, using machine learning to balance audio levels and optimize frequencies. While this provides access to high-quality production for independent artists, it raises concerns about the sustainability of human roles in production. AI tools can enhance creative workflows in music production, providing innovative ways to manipulate and think about musical elements, particularly for sound design and mixing (Deruty et al., 2022). However, integrating these tools into established workflows is challenging and requires adjustments in how professionals approach music creation. While these tools can assist in the production process, the potential for fully automated production could reduce demand for human producers, especially in areas where efficiency and cost-effectiveness are prioritized over creative artistry.

Generative AI also brings new legal and ethical challenges, particularly in intellectual property rights. For instance, the replication of Drake's voice in 2023's viral track "Heart on My Sleeve" sparked controversy over AI's ability to mimic famous voices, which is noted as a

significant copyright concern (Dash and Agres (2024). This capacity of AI to replicate distinct human characteristics blurs lines of ownership, raising complex questions about the authenticity and integrity of AI-generated content within the music industry.

To better understand AI's impact on the music industry, I will conduct a discourse analysis on relevant resources from the past 15 years, including interviews, news articles, and researched publications. This analysis will focus on the narratives and ethical concerns raised by industry professionals, providing insights into how AI is shaping creativity and labor in music. Through qualitative analysis, I will identify recurring themes and examine the unique ways AI affects different sectors—composition, performance, and production. This research will explore not only the practical effects of AI but also the larger societal and ethical implications of these technologies.

Despite the competition AI poses, human composers, musicians, and producers continue to bring irreplaceable qualities to the music industry. AI's limited algorithmic modeling restricts its ability to replicate the full creative processes involved in composition, which means the need for humans is still significant (Roads, 1980). While AI-generated music brings efficiency, accessibility, and new creative possibilities to the industry, it cannot yet fully replace the deeply expressive contributions of human composers, musicians, and producers. AI may enhance certain aspects of music production and provide new tools for artistic exploration, but it fails to replicate the complex emotional authenticity that comes from human experiences and perspectives. This question of how AI-generated music in commercial production affects human composers, musicians, and music producers will require ongoing discussion and ethical consideration through the lens of discourse and qualitative analysis to ensure that AI serves as a complement to, rather than a substitute for, human creativity and skill.

Conclusion

Ultimately, while AI-generated music offers new opportunities for creativity and accessibility in the music industry, it also challenges the traditional roles of composers, musicians, and producers. Generative AI can streamline production processes and provide lower-cost, high-quality options for independent artists, but it risks diminishing the value of human expertise and artistry. With AI generation software, it now competes with human professionals in composing, mixing, and mastering music, raising urgent questions about job security and the authenticity of music production. This discussion matters because AI is reshaping the music industry and our cultural relationship with creativity and art. Music is not just entertainment, but also an expression of human emotion, experience, and identity. The increasing use of AI in its composition and creation challenges the authenticity and emotional depth that humans bring to music. As AI becomes more complex, it raises questions about the role of the artist and their careers as technology gradually overwhelms the creative processes. Therefore, understanding AI's impact through discourse analysis provides insights into how the perception of AI shifts in society, which will help to gain a deeper understanding of how AI and human labor might coexist and enhance one another rather than allowing technology to undermine the unique value that skilled professionals bring to their art. This awareness will help guide the integration of AI in the music industry and strive for a balance between human creativity and technological innovation.

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