Tempo

Harmonizing Artificial Intelligence and Music: The Next Paradigm Shift in Listening

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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 is one of the cornerstones of the human experience. Although the form has changed, whether it be classical or medieval, live or digital, it has always, and will always, be engrained in our everyday lives. Music streaming services have made it easier than ever to listen to music, accounting for 89% of the United States' total music industry revenue in 2024 (Durrani, 2024). With approximately 78% of the US using a music streaming service, people have what they've always wanted, almost unlimited music at their fingertips (Duarte, 2024). However, they now have hundreds to thousands of songs saved within their library, and there is no viable way to *use* them. Music streaming services are great at providing music, however, they lack fundamental features that could revolutionize how people engage with music.

The big three in music streaming are Spotify, Apple Music, and Amazon Music, taking up 90.5% of the market (Smith, 2024). Individually, they provide ways to do more than simply steaming music, such as user profile features to display playlists, recently played songs, and indications for the number of followers and who the user is following. While these profiles may serve certain purposes, I find their approach lacks the level of innovation and thought required to truly transform music engagement. Just as people often use different apps for taking and sharing photos—one for capturing the moment and another for sharing—the music ecosystem lacks an equivalent platform. A dedicated 'Instagram for music' has yet to emerge.

The need for a shift in music engagement is apparent. The widespread sharing of Spotify Wrapped, an annual personalized summary of a user's listening habits, is a testament to the growing desire to engage with other people's music tastes (Purcell, 2023). However, platforms that display listening statistics all year around, like Trackify, highlight the demand for ongoing, personalized music analytics beyond the annual Spotify Wrapped feature (Trackify, 2024).

Furthermore, current media platforms are making up the slack for the lack of music social media by becoming a source of music discovery. In the US, 75% of TikTok users say they discover new artists on the platform (Eliezer, 2021). Additionally, 45% of 18-24 year olds use social media for music discovery (The Harris Poll, 2022). However, the problem isn't solved. Music deserves a platform of its own to reflect the level of importance it has in our society.

Musii is a social media platform to enhance music discovery and sharing among users by creating a feed of music (*Musii*, n.d.). In theory, it's a great idea, but it's not widely adopted because scrolling through a list of shared music isn't sustainable compared to photos and videos. It doesn't compliment the nature of music and the way people interact with it. The recent boom in artificial intelligence (AI), particularly natural language processing (NLP), has the potential to become the final puzzle piece to keep users on the app. People want to share their music. They want to explore new music. They want the right song at the right time for the right experience. The demand for a music experience that allows for seamless sharing, discovery, and personalized recommendations calls for a platform that combines social interactivity and AI to meet user's evolving music engagement needs.

Technical Topic

Tempo is an iOS application that allows users to log in to their Spotify, Apple Music, or Amazon Music accounts to showcase and *use* their music library. The app takes two avenues: social media and AI listening. The social media aspect is just like any other. Users have personalized profiles that display statistics of their listening habits such as genre breakdown and listening history, along with their top songs, artists, and playlists. They can follow friends or find someone new, to learn about their listening habits, or check their compatibility with the compatibility score. Next, AI listening is what keeps users on the app. Simply describe what you

want to listen to: “I want something similar in vibe to Mt. Joy,” “Give me only John Mayer and the Grateful Dead,” or even “I’m driving to Maine to go snowboarding.” NLP takes your prompt and curates a tailored, infinite queue of music that perfectly matches your request, played directly on Tempo. The music will either be from your music library, the people you follow, or anyone on the app depending on your preferences.

The platform will initially be designed using Apple’s SwiftUI framework to distribute the app on the Apple App Store. Since Apple accounts for approximately 60.77% of the US smartphone market, it is a favorable market to initially launch the product (Backlinko, 2024). SwiftUI allows developers to build the front-end functionality, the portion of the app that the user interacts with such as buttons, text, and the overall flow of the app, for example. However, it relies on additional components to become fully functional.

These additional components are called APIs (application programming interfaces). They allow developers to integrate and utilize functionalities from other services. The OpenAI API provides the processing power to connect a text description to a list of songs. It outputs moods, songs, artists, or genres that best encompass the user's prompt. This output is then fed into the next string of APIs: Spotify, Apple Music, and Amazon Music. These allow Tempo to access a user's listening habits and music library to populate the app with listenable content and useful statistics. The last API is Google’s Firebase, which functions as the overall data storage for the app. Although the music and statistics information is available through the streaming service APIs, Firebase allows us to store users' basic information, followers, preferences, and any other miscellaneous information required for the app’s functionality.

Tempo represents a shift in how people engage with music. The AI recommendation feature provides a direct cause-effect link between user requests and music suggestions. Placed

within the pre-existing social media and music streaming market, Tempo is built on a foundation of established technologies with a proven track record. Although gauging user satisfaction is challenging due to the subjective nature of music recommendations, incorporating quick feedback mechanisms like thumbs up or down can help refine the algorithm. However, since not all users engage with these features, analyzing usage data remains crucial for gaining insights into user preferences (Sarewitz & Nelson, 2008). By integrating AI-driven recommendations with social features, Tempo aims to transform how users discover and interact with music. This approach not only enhances the user experience but also reflects broader shifts in technology and science, particularly the evolving role of artificial intelligence in society.

STS Topic

The advances in AI symbolize a paradigm shift in computer science. Thomas Kuhn's *The Structure of Scientific Revolutions* provides a framework to describe scientific developments, such as AI (Bohm & Kuhn, 1964). In AI research, the "normal science," as Kuhn referred to it, followed the symbolic AI paradigm, where intelligence resulted from logical processes and explicitly defined rules (Sirovy, 2024). However, this method had trouble with human decision-making in unpredictable contexts where many real-world problems usually reside, representing the “anomalies” in Kuhn’s framework. The AI “crisis” in the 1980s, coined the "AI winter,” was caused by rule-based systems' inability to scale to complicated, real-world situations (Thorwirth, 2021). The development of machine learning—more specifically, deep learning and neural networks—which can identify patterns in large volumes of data, brought about a paradigm change (Alzubaidi et al., 2021). This has now become normal science. This represents Kuhn's argument that scientific development is cyclical.

The effects of this shift are propagating into every industry. It's the catalyst for the next paradigm shift in the music industry: leveraging streaming service data to deliver highly personalized listening experiences. Tempo is the result of this shift. Now, what does the new normal science of AI mean for society in general? The full spectrum of positive and negative impacts is not yet clear, but, the technology is likely not going away. The Collingridge Dilemma is a concept developed by David Collingridge that describes the inherent challenges in controlling and predicting the effects of new technology (Collingridge, 1980). In the early stages of a technology's development, its full range of potential consequences is not yet apparent. However, once the effects become evident, it's often deeply integrated into societal and economic systems.

Deep learning and neural networks are at the crux of this dilemma as they become integrated into our society alongside a developing regulation framework (Liu, 2024). Although some federal actions have been taken, such as the Executive Order on the Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence in 2023, the critical question remains: will a comprehensive regulatory framework be implemented, both locally and globally, before the technology becomes too advanced and ingrained into our society (The White House, 2023)? Technological regulation is necessary, however, it won't reduce AI to only positive or negative outcomes. It only restricts which outcomes are possible on both sides. This is because of the inherent balance within our society.

For every beneficial application of a technology, there is an equal and opposite harmful application. For example, researchers at MIT have discovered a new antibiotic, halicin, using AI-driven identification (Wong & Collins, 2023). That same technology holds the potential to create harmful pathogens (Pillay & Booth, 2024). Machine learning will allow us to solve

problems we never thought possible, while simultaneously creating problems we've never seen before. It's all about balance. One cannot exist without the other. Scientific revolutions should be viewed as a changing of the guards for the problems we can solve and the problems that are created. The only decision an individual has to make within a given paradigm shift is whether they choose to cause the problems or to solve them.

Conclusion

Tempo bridges AI and music engagement, solving a clear gap in current streaming and social platforms. With its AI-driven music recommendations paired with social features, it gives users a straightforward way to discover and share music. It meets users' needs for personal and social music experiences in a way that today's music services don't, providing the right song at the right time for the right experience.

This project sheds light on the positive and negative implications of AI's growth, especially in consumer applications. Tempo shows how AI can be responsibly applied, offering a way to improve how you interact with music and connect with others through shared tastes. The result: a simple, tailored, and social way to enjoy music that makes sense for the way people engage with music. It can be used as a case study to bridge the conversation to pressing topics such as healthcare and information dissemination, and the responsible regulations that should come with balancing innovation with ethics.

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