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The impact of artificial intelligence on musicians

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Abstract

Generative artificial intelligence (AI) is forecasted to have more of an impact on some occupations and industries than others. We examine the impact that AI will have on musicians and singers. This analysis provides an interesting example as musicians typically engage in physical activities when playing, performing, and use creativity when writing songs. We contribute to the existing literature by linking AI to both an occupational analysis and delving into the emotional aspects AI might not be able to provide for musicians. We explore the pros and cons of using AI for the creation of AI generated music. Further, this paper explores music creation to focus on production and performance. Additional consideration is provided regarding the legal and ethical considerations of AI for musicians.

Keywords: artificial intelligence, musicians, generative artificial intelligence

Introduction

In recent times, artificial intelligence (AI) has reached new heights of capability and public interest. One of the many questions AI has given rise to is: what impact AI will have on various occupations and industries. AI can either help (complement) or take the place of (substitute) work undertaken by people (Felton et al., 2023). In a study on the impact of AI on various occupations, it was and that AI is most likely to impact white collar jobs that require both high levels of education and of information processing (Felton et al., 2021). Occupations least affected by AI were found to involve manual labor (Felton et al., 2021). Of relevance to this publication are musicians and singers, they provide an interesting case of labor as they involve a physical aspect (playing or performing) while also often involving various creative activities (writing, arranging, etc.).

Below are the work activities that musicians and singers typically engage in, as provided by the National Center for O*NET Development (2024):

- Performing for or working directly with the public
- Establishing and maintaining interpersonal relationships
- Identifying objects, actions, and events
- Processing information
- Thinking creatively
- Getting information
- Judging the qualities of objects, services, or people
- Communicating with supervisors, peers, or subordinates
- Making decisions and solving problems

- Updating and using relevant knowledge
- Analyzing data or information
- Organizing, planning, and prioritizing work
- Developing and building teams
- Performing general physical activities
- Monitoring processes, materials, or surroundings

Generally, the overarching activities of musicians that encompass the work activities listed above involve the creation of music and lyrics, and the production and performance of that music. Technology has always shaped what musicians do and how they do it. AI is already used by musicians in various ways (e.g., autotune and Pro Tools); however, current developments in AI provide more scope than in the past for the use of technology by musicians. The focus of this paper is on the creation, production, and performance of music in the form of songs that also have vocals delving into the problems created by this "new" technology. However, AI can also be used to create music that can be used for video content such as YouTube videos, advertisements, and event announcements (Frid et al., 2020).

Using AI to write music and lyrics

Musicians and researchers have been developing automatic lyrics generation (ALG) for years. The use of AI is more compelling now because of increased computational power and the advent of new artificial intelligence (AI) technologies like deep-learning systems. Moreover, the advancement of artificial technologies like natural language processing (NLP) have created new interest in the realm of emotional aspects of lyrics creation using AI tools. In this paper, we explore various methods of lyric creation using AI and the potential impact of emotional content of the lyrics on listeners.

Computer generated music

Software has been used to compose music without human intervention for several years. Initially, researchers used algorithms, step-by-step software procedures and instructions designed to perform tasks efficiently, for Automatic lyrics generation (ALG). Cope (2006) in his book "Experiments in Musical Intelligence" discussed how he started experimenting with computers to create music as early as 1981. His software, "Experiments in Musical Intelligence" (EMI) could examine music composed by humans and generate novel musical compositions in the same style. Cope's first exploration involved coding the rules of basic part-writing. After many trial and error iterations, his computer program produced what can be described as a "vanilla music." type which basically adhered to those rules.

Logan et al. (2004) collected lyrics and used PLSA (Probabilistic Latent Semantic Analysis), and k-means clustering methods to classify music and determine artist similarity. Tra-la-Lyrics system generated lyrics using heuristic rules based on a particular melody (Oliveira et al., 2007). Ramakrishnan et al. (2009) produced lyrics for a given melody in a two-step process. The first step analyzed the input melody that resulted in a series of syllable patterns in Knowledge Navigator Model (KNM) representation schema along with tentative word and sentence. The second step filled the syllable pattern with words from the corpus that matched the given syllable pattern and any rhyme requirements using Dijkstra's Shortest Path Algorithm. Bhaukaurally et al. (2013) created a software tool that generated lyrics in the Mauritian Creole Language. Markov models to improve style and topic coherence were used to generate lyrics (Barbieri et al., 2012; Watanabe et al., 2014).

Artificial Intelligence generated music

Various software has been proliferated using traditional Artificial Intelligence (AI) techniques such as natural language processing (NLP), speech recognition algorithms, and case-based reasoning (CBR). WASP (Wishful Automatic Spanish Poet), another lyric generating software, used an NLP algorithm to generate lyrics from users' inputs and used their words as seeds in a forward reasoning rule-based AI software (Manurung et al., 2000). ASPERA software employed CBR to generate lyrics from a given text that was found like stored cases of existing lyrics (Gervas, 2001). Mahedero et al. (2005) used natural language processing tools to classify and look for similarities between lyrics to obtain results that were 92% accurate. Pudaruth et al. (2014) generated song lyrics using the Stanford PoS Tagger, which is a probabilistic Part of Speech Tagger developed by the Stanford Natural Language Processing Group. Two software tools, Titular and LyriCloud, were developed to create lyrics for musicians. Such software filtered certain words out and created song titles. The software system gave satisfactory results but did not make much sense (Pudaruth et al., 2014). Avdeeff (2018) contended that SKYGGE's "Hello World" album is the first true collaboration between AI and humans and Amper as the world's first AI music composer.

With the advent of deep learning, AI techniques such as artificial neural networks (ANN) and reinforced neural networks (RNN), ALG has transitioned to better lyric creation tools. ANN contains artificial neurons arranged in a series of layers—an input layer, an output layer, and many hidden layers. Data is received in the input layer and the data passes through multiple hidden layers to transform into output in the output layer. As the data transfers from one layer to another, the neural network software learns from the data from the past layer. RNNs are a type of deep learning model specifically designed to handle sequential data, such as text and speech data. Unlike ANNs, RNNs contain a feedback loop from previous layers when making predictions (see, generally, Tyagi & Abraham, 2022). Several studies on ALG employ RNNs to generate lyrics. Lyrics have been generated by predicting the next sentence or next words (Malmi et al., 2016; Wu, et al., 2019). Zhang et al. (2020) used Generative Pre-trained Transformer (GPT2) model to generate lyrics. Youling, the AI-assisted lyrics creation system, supports interactive lyrics generation and a revision module for users to revise undesirable sentences or words. Chen and Lerch (2020) used Sequence Generative Adversarial Nets and RNNs to generate melody-conditioned lyrics.

Emotional component of AI generated music

Lyricists and composers have used emotion in their music to elicit feelings, bring tears, share experiences, and trigger specific memories in their listeners (Johnson-Laird & Oatley, 2008; Perlovsky, 2010). An understanding of the emotional component of AI generated lyrics has motivated researchers and is discussed in this section of the paper. AI algorithms can generate lyrics by analyzing patterns, structures, and styles from existing music. There are several platforms such as Amper, Rytr, UPDF AI, Beatopia, Jukedeck, Freshbots, LyricsStudio, AIVA, Sudowrite, Jarvis, and Boredhumans, to name a few, which can generate lyrics using AI. These platforms generate lyrics and share several following features:

- Choice of various music genres;
- Emulate a particular artist style
- Fine tune lyrical content to suit needs;
- Generate superior quality, meaningful, well-crafted, and engaging lyrics;
- Match lyrics with the mood of a song;
- Offer creative prompts and inspiration to help kick start lyric writing;
- Random generation and word association to spark unconventional ideas; and
- Good user-friendly interface.

However, creating music with the depth, experience, and emotional resonance of humans is a distinct issue with these platforms. Emotions are the essence of human communication and music. Parrot (2001) classified

emotions at a primary level consisting of love, joy, anger, sadness, fear, and surprise. Similarly, Indian classical music elucidates nine emotions as *navarasas* including *shringara* (romance), *hasya* (joy, humor), *karuna* (sadness, compassion), *raudra* (anger), *veera* (courage, confidence), *bhayanaka* (fear), *bibhatsya* (repulsion, disgust), *Adbhuta* (surprise, amazement), and *shanta* (peace).

The influence of those emotional essences can be felt through lyrics and their rendition of music. The goal of musical compositions is to convey one or more emotions to connect and resonate with listeners. Take for example, two platforms—Amper and Jukedeck. Both platforms produce music to complement other audio-visual content and may not be highly emotionally engaging (Avdeef, 2018). There is extensive research to suggest that music triggers emotions in listeners. When a person listens to pleasant music or even upon hearing just the first few notes of a song, the body secretes dopamine, a neurotransmitter, which triggers sensations of pleasure and well-being (Rahman et al., 2021; Pfizer, 2024). Emotions resulting from listening to music can be used to guide the development of artificial intelligence lyrics. (Zhao et al., 2022). This theory has support from a team of researchers who developed and evaluated an affective brain-computer music interface (aBCMI) that demonstrated that the interface was able to detect the emotional states of the participants based on their emotional states (Daly et al., 2016).

MuseNet by OpenAI (Payne, 2019) uses a deep learning neural network model to create a computer-generated music composition. MuseNet is trained on a vast number of MIDI files and can utilize many different instruments in its compositions. But the question is: while music is great, does it have the emotional impact as human-made music? While MuseNet can replicate musical works and can generate harmonically and structurally coherent musical compositions because of its training with a vast number of existing music compositions, can it be innovative and produce novel compositions? Maybe not! This is because lyricists use their experiences, moods, and subtle tones to create their compositions, and it is not truly fair to demand the same rigor on a computer-generated composition. The lack of emotional depth is a major concern in AI-generated music.

There are several music creation tools. Music creation tools include hardware and software to cater to the different needs and preferences of musicians, producers, and composers and to facilitate composition, production, recording, and editing of music. Music creation hardware and software can be categorized as follows:

Digital Audio Workstations, audio plugins, and mobile apps- Ableton Live and FL Studio are examples of software platforms used for music production. Such software offers features such as MIDI sequencing, audio recording, mixing, and mastering. Audio Plugins, another software, enhances the functionality of Digital Audio Workstations by providing additional effects. Equalizers, compressors, reverbs, and synthesizers are examples of audio plugins. Waves, FabFilter, and Soundtoys are firms who produce popular plugins used by professionals worldwide. As musicians increasingly use smartphones and tablets, a number of popular music creation apps, such as GarageBand have also become popular.

Hardware synthesizers and controllers- With the software, hardware becomes necessary. Several hardware synthesizers and MIDI controllers offer assistance with music creation. Roland, Moog, and Novation produce synthesizers, drum machines, and MIDI controllers.

Virtual instruments and sample libraries Firms such as Native Instruments and Spectrasonics are offering virtual instruments with libraries as samples for musicians to access various sounds and other effects for their compositions.
Something of a contingency approach to music generation systems may be one way in which these systems could be improved in the future:

> "... we believe that often researchers have chosen a specific method or algorithm and developed Music Generation Systems with the goal of using that method rather than trying to create a complete Music Generation System that could benefit from the use of different approaches to face different issues. To this goal, we advocate that a well-studied hierarchical hybridization could give means to face many of the open challenges … and possibly also allow for easier comparison between different methods, thus opening new possibilities for evaluation." (Carnovalini & Rodà, 2020, p. 16).

This observation is echoed by Civit et al. (2022) in a recent review of music generation systems:

> "... we came to realize how different the approach to composition is when using these automatic generators. In our experience, the composer became more of an arranger of different melodies, something like a producer from the 70 s rock and roll scene trying to order the wild creativity of some misbehaving rock stars. Although sometimes frustrating, it is a very creative, fruitful process, one with an endless flow of new ideas from the generators, and we firmly believe that further research needs to be carried out into the relationship between human and AI composers in order to provide a framework in which each of them can make use of their very best qualities." (Civit et al., p. 14).

Producing and performing music and AI

Music production involves activities such as mixing, mastering, sound editing, etc, including autotune, vocal enhancement, voice synthesis, sampling, and remixing. The music producer's role is increasingly becoming less about composing music and more about editing and directing music production (Born et al., 2021). We use the term music production to encompass three activities: arrangement, synthesis and mixing (Zhang et al., 2023). Digital Audio Workstations can help with both music creating and with production (see Knotts and Collins, 2021, for an historical overview). Digital Audio Workstations have been around for decades, but their portability has increased, while costs have declined. This means that even amateurs can produce high-quality music with the likes of Pro Tools. Music production can also occur within the contexts of improvised playing or live performances (Deruty et al., 2022). In these endeavors, AI tools are inevitably focused on "responsiveness and real- time interaction." (Deruty et al., 2022, p. 37).

Music production is inherently challenging as it often involves combining different audio tracks in a seamless manner. This process involves "high levels of subjectivity in the creative process [and] makes computation understanding of the mixing process very difficult" (Moffat & Sandler, 2019, p.2). One key element of music production when using AI is *control*. That is: how much control will the producer give over to the IMP system? There are four main approaches to control (Moffat & Sandler, 2019): *Insightive*, where AI systems take on a supportive role providing insights to the producer about the audio characteristics, identifying areas that may be worthy of human tinkering. *Suggestive* approaches not only analyze an existing mix, but they provide recommendations to the human producer on how the mix can be improved. *Independent* approaches involve a human engineer providing the AI system with specific tasks to improve the mix. Finally, *automatic* approaches involve the human producer giving the AI system complete control of a mix, with specific goals or parameters being set by the human (for example, mixing with a particular style or sound in mind).

From a production perspective, artificial intelligence has been used to improve the mixing of audio tracks into final musical pieces (McGarry et al., 2021). Efforts in this regard include modeling the mixing process

itself, automated audio effects, instrument identification, production workflows, and process tracking (McGarry et al., 2021). AI systems can be particularly useful at improving the quality of music audio. "Creativity still requires technical skills. To achieve something wonderful when mixing music, you first have to achieve something pretty good and address issues with masking, microphone placement, level balancing and so on." (Reiss, 2022). In the realm of music production, some argue that AI can help augment the skills of musicians when talented producers are not available: "The real benefit is not replacing sound engineers. It's dealing with all those situations when a talented engineer is not available; the band practicing in the garage, the small restaurant venue that does not provide any support, or game audio, where dozens of sounds need to be mixed and there is no miniature sound engineer living inside the games console" (Reiss, 2022).

One commonly used production technology is Auto-Tune, which allows for real time pitch correction or correction when mixing, so that vocals are in pitch-perfect sync with key of the related music in studios or live performances. Auto-tune has been criticized for making vocals sound robotic and for improving the vocals of singers that may otherwise not be all that talented: For example, the lead singer of Death Cab For Cutie, Ben Gibbard, observed at the Grammy's in 2009: "Over the last 10 years we've seen a lot of good musicians being affected by this newfound digital manipulation of the human voice, and we feel enough is enough," declared frontman Ben Gibbard. "Let's really try to get music back to its roots of actual people singing and sounding like human beings" (qtd in Reynolds, 2018). Not surprisingly, efforts to improve auto-tuned vocals have focused on making them sound more natural. One recent example is a diffusion-based pitch-correction model, Diff-Pitcher, which is the first diffusion-based pitch-control corrector (Hai & Elhilali, 2023). The researchers found that Diff-pitcher "outperforms previous pitch control methods in sound-quality and naturalness with great pitch controllability" (Hai & Elhilali, 2023, p. 1).

AI can also be used to improve the creativity of musical outcomes. One way in which AI can support musicians is through creating opportunities for creating unexpected or creative outcomes (Deruty et al., 2022). This could involve creating "situations with a rich potential for unexpected results. This may mean using different prototypes together or along with third- party tools, modifying models in an unorthodox way to fit some specific purpose, or using models for applications they weren't conceived for. ... AI tools that work with audio offer better chances of a lucky find in the music production process than MIDI tools, simply because they can be driven by a wider range of inputs available in the DAW project. In a more practical vein, enabling artists to benefit from serendipity may be as simple as keeping a record of their interactions with the AI tool, and capturing the outputs ...." (Deruty et al., 2022, p. 45).

Music distribution platforms such as Spotify, Apple, and Amazon Music influence how music is produced. In 2024, these platforms are the primary ways in which most people listen to music. There are two major ways that streaming platforms influence music production (Born et al., 2021). First, through policies, rules and guidelines. And second, through the infrastructure and algorithms used. Those algorithms may make recommendations of songs that are similar in style to those that listeners already have consumed. The length of songs themselves is likely a function of the ability to generate revenues and of the changing preferences/shortened attention span of listeners (30 seconds on Spotify, until recently).

The performance of music (for recording or for an audience) is another area in which AI helps musicians. As Deruty et al. (2002) observed: "Another type of music production is live performance and improvisation. This includes instrumental performances with or without a predetermined score or schema to structure the performance. AI tools in this context tend to be focused on responsiveness and real time interaction." (p. 37). Some of the tools already mentioned can be used for music performance (e.g., Auto-Tune).

Conclusions and discussion

AI can certainly assist in writing and arranging music lyrics. Using AI tools, musicians can generate lyrics, chord progressions, and even arrange lyrics to suit various styles and preferences. Ampler Music, AI virtual Artist (AIVA), IBM's Watson Beat, and Google Magenta are examples of tools that can be used to generate and arrange music lyrics. Ampler music (Cheng, 2023) is a tool that can generate unique music compositions based on user input that includes mood, style, and preference of instruments.

When used by musicians, AI may have some potential problems in terms of acceptance. For example, in a study of consumer perceptions, Tigre and Maw (2021) found "... a rather negative perception, low purchase intention for AI music and a negative credibility perception of musicians using AI. [However,] Findings from the experiment indicated no significant differences between the groups, suggesting that the awareness of the use of automation did not influence the perception towards the music." (p. 137). Zulic (2019) speculated that, if AI has not created art that emulates human emotions yet, it will surely do so in the future.

Musicians have expressed concerns regarding the legal issues of AI in composing music. Such concerns include copyright infringement, impact on royalties, and the ethical use of AI technology. A major issue in AI-generated music is its potential to infringe on existing copyrights. Since AI learns from large datasets that include copyrighted music, the resulting compositions can inadvertently replicate certain elements of those works and raise legal questions about who holds the copyright (Fenwick & Jurcys, 2023). The proliferation of AI-generated music could dilute the market, making it harder for human composers to gain recognition and earn a fair income (Culliton, 2024). Another concern is the use of existing works to train AI models without proper permissions (Lucchi, 2023). Many artists have argued that AI-generated music lacks certain cultural context and emotional aspects that can be brought by human creators (Demmer et al., 2023).

While Generative Artificial Intelligence, powered by Large Language Models (LLMs), have the potential enhance AI-human collaboration freeing time from routine tasks a creative element may exist in the music industry if both used knowledgeably and sparingly to so as not to remove the human element of artistic creation impacting contributing occupations in the music industry in addition to the actual "creator/performers."

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