ML Music Lessons

(Technical Paper)

Technology and 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 is a universal language, providing people across the world the tools to express themselves, form community, and inspire others. Creating and performing music provides an escape and can offer people peace and healing from the struggles of their lives. Music should be accessible to everyone, but the expenses of purchasing an instrument and paying a private teacher avert many aspiring musicians. This technical project aims to research the potential causes of disparity in access to music and work to bridge that gap by creating an educational tool for self-taught flute players. The application will analyze a flute player's sound and provide feedback on note accuracy, tone quality, vibrato, and articulation. A machine learning algorithm will learn from a dataset of famous flutists' recordings and analyze the sound waves of the user input. The STS project will involve researching the impact of technology on the music creation process, the reception of music, and the demographics of musicians.

Technical Topic

Music education can be very expensive and is not accessible in an equal capacity to everyone. Many children in the public and private school systems have the opportunity to learn music in a classroom setting, but they often do not receive any individual training or personal feedback. This puts children from lower-income families at an unfair disadvantage, as their parents cannot afford expensive weekly private lessons from a skilled instructor. Children without access to private instruction may feel discouraged, as they are not making as much progress as their peers, which may cause them to abandon their music education. Learning music provides many great benefits for children. Daily practice enforces a strong work ethic and instills the importance of dedication. Many of these skills can be transferred to other areas in school and work. A study of over two thousand 11-12 year-olds found that children with access to a musical

instrument achieved higher standards academically (Young, Cordes, & Winner, 2014). Technical skills are acquired through hand-eye coordination, fine motor control, sheet music fluency, and repetitive practice. Good musicianship also requires creativity for the phrasing and musical ideas that go into performing or composing a piece. The act of learning an instrument can improve cognitive function, mathematical ability, and spatial reasoning (Santos-Luiz, Coimbra, & Silva, 2009). These benefits should be available to all children, regardless of socioeconomic status. In a study of an afterschool music program, parents were asked to complete a survey evaluating their child's performance and behaviors after completing the program. The children who participated in the program for more than three hours per week scored significantly higher in responsibility and discipline than the children who participated for three hours or less (Whitson, Robinson, Van Valkenburg, & Jackson, 2019).

The technical project will culminate in a machine learning algorithm that will analyze flute playing and provide productive feedback. The algorithm will learn from a training set of professional skilled flutists to detect desirable qualities and analyze the sound waves of user-provided input. I will use Digital Signal Processing (DSP) and Music Information Retrieval (MIR) techniques for the audio analysis tasks to detect pitch, duration, and melody from a WAV file. I will use the ml5.js library for pitch detection. The tone quality will be extracted using the Mel-Frequency Cepstral Coefficient (MFCC). The extracted audio information will be analyzed, and basic constructive criticism will be provided to the user. The machine learning component will be completed by January 19th, 2022, and the focus for next semester will be the web application and presentation.

STS Topic

Music can both reflect and influence a society's culture. Numerous studies have proven that different genres of music elicit strong emotional responses in people and can have large impacts on their mental state (Vuilleumier & Trost, 2015). Songs with aggressive lyrics targeted towards the opposite sex tend to elicit more aggressive behaviors in men and women (Fischer & Greitemeyer, 2006). Classical music has the potential to increase calm and emotional well-being. Techno-music, on the other hand, can raise heart rate, systolic blood pressure, and hormone levels (Gerra, Zaimovic, Franchini, Palladino, Giucastro, Reali, ... & Brambilla, 1998). The rise of EDM, hyper-pop, and digitally-altered music may be a factor in the shift in the culture over recent years. This genre of music may be a reflection of a select few's inner worlds, but the music they create influences millions of others. A generation immersed in technology since birth, Gen Z is held to unrealistic standards of perfection, through perfectly curated social media sites, face-altering filters, and photo-editing apps. These same beauty standards are infiltrating the music industry. The natural imperfections found in acoustic instruments and unaltered vocal tracks sound more drastic to our ears that are now accustomed to pitch-perfect tones. Just as someone scrolling through an Instagram feed of photoshopped celebrities would start to lose self-esteem as they picked apart each of their flaws, a young musician is more likely to be discouraged when they subconsciously compare themselves to the music of our pop stations. As electronic music becomes more popular, acoustic instruments and genres of music such as classical, jazz, and folk are fading in popularity. With the use of auto-tune on acoustic instruments and perfectly-pitched electronic noises, there is no room for imperfections. Self-expression must be perfected and staged. Technology undoubtedly alters the creative process in music-making, whether that be encouraging or hindering it (Warner 2003). With the rise of technology in music, new questions arise, such as, what constitutes "good music"? Does the

digitalization of music detract from its inherent value? (Pinch & Bijsterveld, 2003). I hope to explore whether technology stifles creativity and expression of emotion or provides another outlet for expression.

Technology allows artists to learn new skills and techniques online for free, making these crafts much more accessible to the public. Digital mediums of art provide another way for artists to express themselves. These digital mediums require a subset of skills distinct from those required for their physical counterparts. While music used to be limited to the set of existing acoustic instruments, the possibilities for sound and experimentation are endless for the current-day musician. Electronic music may be more than just another tool in the creative belt of a musician; the digital alteration of music could allow for all of the previous rules of music to be broken and new ideas to arise.

How does the use of technology change the content, emotion, and subtext of art? Are the messages held within altered due to the medium? Do these digital mediums encourage more artists to pursue them, as they may seem less intimidating? Do they discourage artists from pursuing analog forms of art, or inhibit self-expression? These are all questions I hope to explore through this project.

For years, the music industry has lacked diversity in performers, composers, conductors, and producers. I hope to explore how the rise of technology in music has affected this issue. While 21.6% of popular music is by women artists, only 2.6% of producers are women (Smith, Pieper, Choueiti, Hernandez, & Yao, 2021). The rise of popularity of electronic music is shutting women out of the music industry even more than they have been in the past. Another study found 55% of students pursuing Traditional Music degrees were female, while only 10% were female in Music Technology degrees (Born & Devine, 2015). Women lack representation in many

STEM disciplines, and as music becomes more technologically focused, they lack representation there as well. While there is a large gender disparity, there may be more racial diversity in Music Technology students than in Traditional Music programs (Born & Devine, 2015).

I will research this topic under the framework of Actor-Network Theory to analyze the many shifting relationships between music educators, students, artists, the music produced, the technological tools available to musicians, and the audience that consumes this music. There are human and non-human actors in this system that all contribute equally to the network of the music industry and surrounding music culture. The current state of music is constantly changing as new artists and music are introduced. The introduction of music technology is another actor entering this network that impacts each aspect of the music industry. As much as engineers, producers, and musicians have shaped music technology, these technological tools have shaped their creative processes, songwriting, and self-expression. I will use Actor Network Theory to examine the relationships between all of these components and understand how the introduction of technology has and will continue to shape the music industry.

Conclusion

Many young people may be discouraged from pursuing music for various reasons, whether that be the financial burden of quality music education, the pressure for perfection, or the lack of representation in musicians. The technical project aims to help provide a solution to this problem by lowering the barrier to entry for lower-income music students who cannot afford private lessons. This educational tool will make it easier for students to learn on their own. The machine learning algorithm focuses on the flute due to my background, but this could be expanded to include other instruments in the future. A more advanced model could begin to identify additional, more complex features in the musical recording, such as expression and

musicianship. This STS project aims to further explore how technology has impacted the music scene through the lenses of creativity and diversity. Understanding the causes for the lack of diversity in music can allow educational tools to adapt to suit the needs of individuals who may be discouraged from pursuing music.

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