Automated Guitar Robot

Autotune's impact on music aesthetics

A Thesis Prospectus

In STS 4500

Presented to

The Faculty of the

School of Engineering and Applied Science

University of Virginia

In Partial Fulfillment of the Requirements for the Degree

Bachelor of Science in Computer Engineering

By

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October 27, 2022

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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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General Research Problem: Automation in Music Industry

To what extent does automation technology influence the music industry?

As today's software and hardware technology is gaining popularity and influence into people's daily lives, more and more processes or products are being automated for purposes of higher efficiency. For example, production lines in manufacturing industries have been automated by electrical control systems so that the production can achieve higher productivity, while freeing workers from performing dangerous and repetitive manual production. Under this trend of automation, the music industry is not an exception. From music creation to recording, music production nowadays rely heavily on software and hardware technologies. Software tuning, virtual instruments, as well as MIDI technology allow people to use millions of sound effects in their music creation process (Master of Music Program, Southern Utah University, 2021). They provide great convenience and inspire creativity for musicians during music production. However, autotune as a more controversial technology, which originated in 1996, could possibly lead to loss of authenticity and diversity in music.

Therefore, this paper asks the question, to what extent automation technology influences the music industry? It is important to delve into this topic because it is important for readers to understand how automated musical technology affects their tastes in music. On the one hand, it can be used to help advance music education. The technical project investigates how automation technology is applied to build an automated guitar player robot, which can be great assistance as a musical educational tool for guitar beginners, using knowledge in both software and hardware, such as GUI software applications development, embedded systems design, etc.

On the other hand, the STS research question takes a step back and examines how automation technology, specifically autotune, could bring potential positive and negative social effects on music aesthetics of the general public. Overall, these projects work together to identify whether automation technology can advance or deteriorate the development of the music industry.

Automated Guitar Robot

How to build a music educational tool that automatically plays guitar chords with user inputs?

Music education, especially music educational tools, pale into insignificance to the general public nowadays, who focus more on other areas of education. According to Kenneth Elpus, "music education has always required advocacy", and "music teachers are increasingly called on to justify their existence and importance in schools" (Elpus, 2010). Reported by the School of Education at Columbia University, during COVID-19 when musical instruments are left in locked-down schools, a music teacher Katy has to come up with creative ways to teach music online, such as conducting an interview with students' parents to ask about their perspectives on music (Giegerich, 2020). The music education budget cuts also seriously impacts school districts that serve low-income communities (Peralta, n.d.). The lack of music educational tools play an important role in this phenomenon, which is why it is important to build an accessible music educational tool like automatic guitar robots. This tool can fill in the gap in music education and help advance aesthetic training.

There is another important reason why an automatic guitar robot is needed: beginner guitar players often find it difficult to find the correct frets and strings to play chords properly. The memorization and practice that are required to perform correct fretting and plucking are usually enormous, especially for beginners who have little knowledge in music theory. According to calculations, there could be 2210 total guitar chord combinations (Bobby, 2022). Many of them flinch and give up on precious opportunities to enjoy and perform guitar masterpieces. It matters to rookie guitar players to climb the learning curve faster. Hence, the goal of this project is to create an automated guitar robot for guitar beginners who struggle to learn chords and therefore to contribute to the development of music education.

The automatic guitar robot is built with several deliverables. They mainly consist of GUI application, microcontrollers, servo motors, wooden guitar frame, and a guitar. As Figure 1 shows, the wooden guitar frame is used to hang servo motors above the first six frets to perform fretting and above all six strings to perform plucking. Covering only the first six frets would be enough to cover all diatonic chords in 12 keys, which is enough for guitar beginners to ramp up. The servo motors used for fretting are equipped with linear actuators. The servo motors used for plucking are equipped with guitar picks. A microcontroller, MSP430FR2476, will be used to control the servo motors. The microcontroller will be communicating with a GUI application via a Bluetooth module.

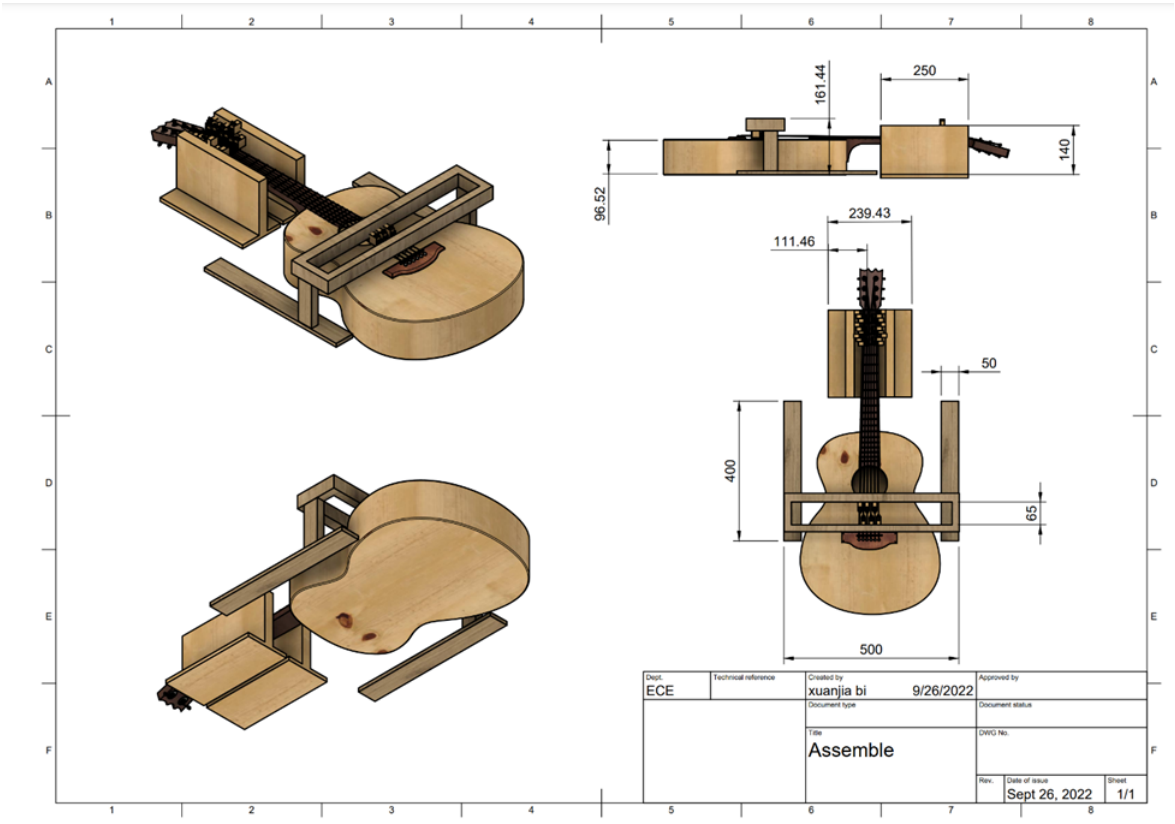

Figure 1: CAD Design of Guitar Frame

The way that these deliverables work is shown in the block diagram below. Users can type guitar chords in a text box, or they could import a text file into the GUI application, which preprocesses the inputs and transmits the data via Bluetooth module ESP32 Pmod to MSP430. Once MSP430 receives the preprocessed chord information, it will select corresponding servo motors by sending appropriate PWM signals. Then, the servo motors, which hang above frets and each string, will perform fretting and plucking correspondingly. For fretting, the servo motors turn and bring the attached linear actuators down to desired fretting locations. For plucking, the servo motors turn 90 degrees to pluck a string. Overall, the ideal result should show that as long as users input guitar chord information, the guitar robot should be able to

play chords correspondingly. This project can provide a solid basis for other music robots in the future that play various musical instruments, such as bass, ukulele, drums, etc.

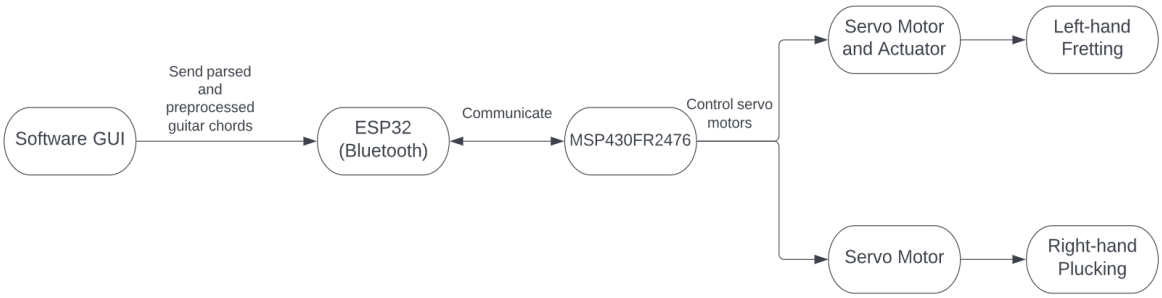

Figure 2: Block Diagram

Autotune's impact on music taste

What effects does autotune bring to the music aesthetics of the pop music listeners in the U.S. and China?

For the STS project, the main focus is about studying the negative and positive effects of automation on music aesthetics. A common complaint of modern music is that it sounds worse in terms of music production and tastes (StereoMonoSunday, 2019). A general question can be raised from here: what effects does autotune bring to music aesthetics of the general public? As a musicophile growing up in China and currently studying in the U.S., this question will be

investigated under a comparative study of American and Chinese pop music. The result of this research could help readers understand better why complaints exist by conducting a case study on autotune, which is an essential automation technology in the music industry, and help readers understand whether autotune advances or deteriorates the development of the pop music industry in the U.S. and China.

As indicated above, autotune is an automated pitch correction technology long used in popular music. Essentially, when a musician sings into a microphone, the voice is adjusted to fit the notes of chosen instruments (Murphy, 2022). Musicians and singers use autotune mainly because it is an extremely useful and convenient tool for music production: it helps tighten up pitch imperfections, create vocal effects, improve live performances, etc (George, n.d.). On the one hand, the groups that are directly benefited and impacted by this are the pop music singers and songwriters. Some of them warmly welcome this technology, as autotune brings new opportunities for music creation just like synthesizers in the 70s, and they state that people should not be afraid of trying new things (Gill, 2001). T-Pain, the famous R&B singer and rapper, claimed that he enjoys talking about technologies used behind his music and he even studies them to "better understand his craft" (Sniderman, 2011). He embraced autotune in his music creation because he believed that "anyone's voice is just another instrument added to the music" (Sniderman, 2011). Some other musicians claim that autotune can also help better convey expressions and feelings. In China, a famous rap singer named Kris Wu, who frequently uses autotune in his recorded songs and live performances, claims that autotune is merely a filter, not Photoshop.

On the other hand, some people despise this trend and believe that autotune is too widely used. For some music listeners and critics, autotune also could change their way of perceiving and consuming music. Some musicians also argue that the imperfection and off-keys in pitches and vocals actually diversify the aesthetics of music, and the occurrence of autotune unifies all sorts of music creation into a standardized form, which is detrimental to the development of music creation (Provenzano, 2018). Furthermore, Trey Parker, a famous film director, once found through experimentation that one has to sing off-key in order to have autotune come into effect, and hence he claimed that only bad singers would use autotune (Raiwet, n.d.).

Therefore, it can be argued that there are several social groups involved around this issue: musicians, music listeners, and music critics. Within each of these, there is a split in terms of perceiving autotune as a beneficial or detrimental tool to the music industry. On the one hand, some musicians, listeners, and critics root for autotune and believe it advances the aesthetic development of music. On the other hand, other musicians, listeners, and critics believe that autotune erodes the authenticity of music and the work ethic of musicians.

In order to investigate this issue, I will focus on American and Chinese pop music. Firstly, I will start out investigating the origin of autotune, why it emerged, how it helped American pop music (rap music in particular) back then, and how it became prevalent in the Chinese pop music industry, by reading through several scholar papers on the history. This will help readers understand how musicians opened the black box and how music listeners perceived this revolutionary change made by musicians. Then, I will investigate how autotune plays an important role in American pop music by conducting case studies on famous American pop/rap

singers who heavily rely on autotune for music composition. This will be done by reading music critiques of some most famous auto-tuned songs of these singers and collecting these songs' popularity-related data from platforms like Spotify. In this study, music critics will be assumed to represent pop music listeners' taste. This will help readers understand how American pop music listeners perceive autotune and to what extent it is welcomed in the American pop music industry. The same type of evidence will be collected for Chinese pop music. The popularity-related data will be collected on Chinese streaming services like NetEase Cloud Music. Both sides' critiques will be compared to observe and predict the trend of autotune under different cultures.

Conclusion

A mature musical aesthetic of the general public is definitely crucial, as it determines the development of the music industry as well as the well-being and healthy mentality of humanity. From STS research, readers can learn how the application of autotune changes the music industry in both countries and shapes the musical aesthetic of music listeners, who in turn affect the music industry as well. From the technical project, readers can understand how an automated tool built by microcontrollers and servo motors can advance music education, which in turn helps advance music aesthetics and encourages development of the music industry. Overall, readers will be able to comprehend how automation technologies shape their interpretation of music.

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