

DESIGNING A COST-EFFICIENT PROGRAMMABLE MULTI EFFECT PEDAL FOR  
ELECTRIC GUITARS

(Technical Paper)

THE TRANSFORMATION OF THE MUSIC INDUSTRY DUE TO TECHNOLOGICAL  
ADVANCEMENTS

(STS)

**A Thesis Prospectus Submitted to the**

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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:**

*How has technology impacted music?*

The origin of music can be traced back to the beginning of civilization itself, as it was a form of expression often used in rituals, communication, and personal or communal entertainment (Montagu, 2017). When looking at the definition of music itself, Oxford's dictionary defines it as a "vocal or instrumental sounds (or both) combined in such a way as to produce beauty of form, harmony, and expression of emotion" (Music: Definition of Music by Oxford Dictionary). However, with the advancement of technology, the definition of music has expanded in such a way that technology is just another instrument in its creation. As a result of this, the music industry has grown to the market potential of \$21 billion dollars (Watson, 2019), reaching an audience of billions. Taking this to perspective, for my STS discussion, I will analyze the impact of technological advancement in the music industry. For the technical research, I will look at one of the initial technologies that advanced digitized music, electric guitars, and will design a cost-efficient programmable multi-effect pedal for it.

**Technical Topic: Designing a cost-efficient Programmable Multi-Effect Pedal For Electric Guitar**

*How does having a programmable guitar effects pedal make music creation more affordable and flexible?*

Guitar pedals are an essential component of a player's sound and what kind of music they produce. By being able to modify the input wave from an electric guitar, pedals can produce a wide array of sounds and effects through the electrical components inside. While current pedals

are a great way to improve your sound, multiple limitations arise when chaining multiple effects together, and is the reason behind the creation of this project (Blasie, 2020). First, pedals are typically engineered to produce a single effect. This is great for specific features, as the electronics are typically simple and can produce a good result, but having to get a different pedal for every kind of effect becomes not only expensive but tedious to carry around and causes competition for space on a guitar player's pedal board. A second drawback to single effect guitar pedals is the chaining of effects that occurs. When a signal is run through multiple pedals, regardless of whether they are on or off, the signal will have loss as it travels through the circuitry of some of the pedals (Fujimaru and Nuzzaci, 2009). By eliminating the chaining of multiple pedals with our "all-in-one" effects unit, we can eliminate the loss of input signal that occurs leading to a cleaner and more robust sound.

While multi-effects guitar pedal units do exist, one of the largest barriers to these units is cost. The industry standard, the Line 6 Helix Multi-Effects Board, runs around \$1700 (Lynham, 2016). While this unit includes some special features, such as the ability to save different pedal profiles and over 70 different effects, the core value of the product lies in the ability to use a single pedal to produce a multitude of effects. The importance of our project is the ability to recreate a similar unit at a much lower cost, while still being able to accomplish the same core features.

The first stage of the project will involve designing and prototyping our circuit which will be done using simulation software such as Multisim and Ultiboard. Once verified that the circuit's designs are working in simulation, we will order the PCB board as well as the verified components to build the circuitry for our effect-box. In order to create the actual effects for the guitar signal, we will utilize Digital Signal Processing methods available for the MSP432P401R

microcontroller board, and program the following digital effects using Code Composer: distortion, overdrive, fuzz, and delay. After completion of the programming and hardware aspects of the project, they will need to be combined to create the full system and then tested for functionality.

The time frame of this project will be from September 1st, 2020 to November 30th, 2020. The expected outcomes of this project are to create a fully enclosed, modular guitar multi-effects pedal that can be instantly added to any signal chain and programmed with a multitude of effects. Potential future work that could stem from this project is to create a mini-library of different effects that can be loaded onto the MSP432 board quickly so programming is not necessary. It will be an open-source library that allows various developers to add their code, so even people without coding experience can utilize the effects pedal.

### **STS Topic: The transformation of the music industry due to technological advancement**

*How have technological advancements transformed the production and distribution of music?*

Music has changed periodically for thousands of years based on the culture and society that utilizes it. However, recent technological advances have revolutionized how music is produced and distributed. I will be researching what technological innovations have had the biggest impact to the music industry in terms of production and distribution of music and look at how it has affected the musical experience within the last few decades.

When looking back in history, music was once an art form that could only be heard through live performances. However, with the invention of sound recording technology by Thomas Edison and Emile Berliner in the 1870's, it started a revolution in digitized music

(Newby, 2017). As a matter of fact, even the medium in which we listen to these digitized music has transgressed quite a bit in the last century. We have moved gradually from records to cassettes, to CD's, and now music streaming services like Spotify.

The main social groups that are affected by my research are artists, producers, and consumers of music. The impact of technology has been mainly beneficial. Some of the positive changes that have resulted from utilizing technology in music are improved production, easier promotion, better distribution, accessibility, and the advancement and emergence of new musical genres. The studio environment itself has changed from an analog environment to a digital environment. In addition, with the emergence of electronic instruments, such as the Electric Guitar, has allowed new types of sounds that would have been impossible to create with standard instruments. Technology has even introduced new genres of music such as electronic dance music (EDM), which is made solely from virtual instruments and effects. It has even revolutionized the vocal aspects of music. In fact, many of the well-known artists use digital effects to modify their voice to a desired pitch and tone.

With all technology, there are many limitations and disadvantages that arise. In terms of the music industry, a few negatives that have risen due to technological advancements are piracy and over-reliance on technology. Due to music being digitized, it could now be read, copied, and transferred between any two computers. Although it made music very accessible, it has also been financially disastrous to artists and producers. In fact, piracy due to digitized music has led to economic losses around 12.5 billion dollars every year according to the Recording Rights Association of America (Siwek, 2007). In addition, the over reliance on technology to create music has affected the quality of music produced. It's often rare to find musicians that have pure

vocal and instrumentation talent due to all the modification that technology offers. Furthermore, knowledge of technology is required to be successful in the field.

To address my research questions, I will evaluate various scholarly articles, datasets, or books about different technologies in the music field and how it has shaped music within the last century. This will require looking at various technological advancements with respect to time and understanding the effect it had on music in that time frame and how it shaped music later in the future. With this analysis, I hope to create a clear timeline of the progression of technology in the music industry. I will also look at how different geographical regions utilized technology based on the culture of that region, and how it influenced or impacted other various geographical regions. In order to understand the current musical experience, I plan to use data provided by music streaming platforms such as Spotify and Apple. The analysis of that data will provide a better understanding of trends in music, and potential relationships with emerging technologies in the field.

## **Conclusion**

Music is something that is ever expanding. It often changes based on the people, culture, society, and the technology that is present at the time. The goal of my STS research is to analyze the impact of technology on music in hope to better understand the state of the music industry currently. With my technical research, I will be utilizing the principle of digitized sounds to create a tool that can help electric guitar artists produce more customizable music, without the limitation of cost and the necessity for additional equipment. Although these research are loosely coupled, the creation of the programmable effect box will have the potential to impact the

electric guitar community. It will provide artists more flexibility in the type of sounds created which will allow them to create music in a more efficient manner. With continuous advancement in music technology, such as this technical research, the music industry is able to continuously grow and change. I hope this research will be useful in better understanding the current state and the potential future of the industry.

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