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Project Proposal

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Introduction

Our product will be a system intended to facilitate the production and dissemination of music, by integrating a microcontroller into a guitar. This microcontroller and accompanying hardware will allow the musician to automatically tune and apply effects to his or her music either in real time or retroactively. It will connect over wifi to a smartphone, which will provide a simple and intuitive touch-screen control interface. The smartphone and wifi connectivity will also allow the musician to share his art to SoundCloud, social media, or other services quickly and easily.

Problem

Guitarists and other musicians often find it helpful to enhance their instruments’ electrical signals with effects, i.e.- distortion, wah, delay, overdrive, etc. These effects are easily realized with fairly simple circuitry. However, these effects circuits are typically manufactured and sold as individual units. Thus, the more effects a musician wishes to apply, the more effects units he or she must operate (usually via foot-pedals.) For songs which require several effects, it becomes space-consuming and confusing to arrange all the pedals at the musician’s feet. Furthermore, the operation of an array of pedals while performing live music is a difficult task for many musicians.

Proposed Solution

Our proposed product will enhance a musician’s ability to apply effects to their guitar by streamlining the process. The device will use onboard circuitry to produce effects normally only capable with multiple effect pedals. Also, by connecting the device to a smartphone app which allows effect selection, the process of choosing effects will also be a more efficient process (as compared to manually adjusting multiple pedals). In addition to the guitar effects aspect of our device, it will also have tuning capabilities and be be able to record audio. Both of these features will be realized through the mobile app that directly communicates with the physical device. The many features of our device will create a streamlined, universal tool that creates a more simple experience for musicians.

Features

We intend to demonstrate the following features of our product:

* A microcontroller universally attachable to electric or electrically reinforced instruments, capable of analyzing the sound quality and making tuning recommendations.
* A module capable of attaching (preferably universally) to the neck and tuning keys of a guitar or similar stringed instrument. This will take tuning instructions from the microcontroller and adjust the the keys accordingly. This will likely consist of a servo and gear system, and should be considered a tentative feature because of the potential difficulties resulting from fabricating the mechanical parts.
* A simple electronics module that can apply basic effects to music as it passes to an amp and speaker.
* A rechargeable battery for the device
* A flash memory unit capable of storing a song for later application of effects or transmission to a smartphone
* WiFi for connectivity to the smartphone
* A mobile app with a GUI for manipulation of the microcontroller by the user
* Tentative idea: detachable hardware effects modules so the user only has to buy and use what they need.

Available Technologies

* PicKit 3 Microcontroller or similar device will be used to control hardware modules and perform basic signal processing.
* Wifi module will be used to connect microcontroller to a smartphone in order to use a touchscreen interface. This will also be used to transmit stored music to the smartphone for posting on social media.
* Op amps and other linear circuit components components to apply effects. Some effects can be applied digitally by the microcontroller if necessary.
* Flash memory module will be used to record a song as it is played. Effects can then be applied retroactively if desired. The song can then be transferred to the smartphone for sharing.
* Commercially available battery technologies, either an integrated rechargeable battery or regular receptacle for 9V, AA, etc.
* 3D printer for fabricating a box, hopefully of ergonomic shape and size.
* Microphone, DAC, ADC and other basic audio I/O components

Engineering Content

* Microcontroller programming: the microcontroller will need to be programmed to mediate and govern interactions between modules in a reliable manner.
* Signal processing: the microcontroller will need to be programmed to analyze audio signals to make tuning recommendations and apply sound effects
* Wireless communication: the microcontroller will need to be able to communicate to the smartphone reliably over wifi
* Mobile app development: a touchscreen interface will be designed in Android or iOS to enable users to easily interact with the device. This may also involve integrating APIs to enable sharing to social media or cloud storage/sharing services.
* Electronics engineering: will need to design and build an analog circuit that can provide a variety of sound effects
* Electro-mechanical systems: will need to design a module that can precisely manipulate guitar tuning keys.

Conclusions

Our device will be capable of multiple effects, as well as tuning and recording capabilities, that make it a universal tool for guitarists and other musicians. The onboard circuitry combine with the mobile app will allow the device’s many features to be applied in a simple, user-friendly way. This will eliminate the need for multiple, bulky components and bring all effects circuitry into a single device with a common user interface.

The simple user interface, as well as cloud and social media capabilities make this product useful for an amateur musician looking to experiment with audio effects, practice his art in a user-friendly way, and share his finished product with others.