Multi-Effect Sound Pedal Sequencer for Performing Musicians

DESIGN DOCUMENT

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1 Introduction

1.1 Acknowledgement

Considerable contribution to this project was made by our client, Randall Geiger, through technical advice and consultation. Iowa State University contributed equipment that proved vital to our project as well.

1.2 Problem and Project Statement

Effect pedals for musicians exist, but adding effects in series or parallel requires stringing multiple pedals up to each other. While some high-end multi-effect pedals do exist, those pedals only allow for one effect to be used at a time, which limits the variety of sounds a musician can make live. Additionally, while attaching individual pedals together would allow for a similar effect, the tradeoff becomes losing dynamic switching, as it would either require stopping the show for a time to switch pedals or would require a large mess of pedals to pull off a show with many diverse effects.

Our solution is to take the general idea of a digital multi-effect pedal and improve upon the design to allow for effects to be added and changed around in series or parallel, which would allow for many different distinct sound types to be possible. Our pedal would take in a sound, apply the effects as configured, and output the new sound through an amplifier. The configurations of effects or order of effects used will be set up through an app developed with the device, which would communicate with the pedal to set up configurations of pedal effects, add/remove effects, and configure the individual effects. This app could configure with the pedal either before a show or be done live.

1.3 Operational Environment

The end product will consist twofold of the pedal itself, and the display of which the pedal will be configured. The main operation of the pedal will be done via foot operation by the user, and thus will be on the ground in a variety of different stages. The pedal therefore must be durable enough to withstand long-term hard use (potentially heavy stomping on the pedal switch itself and to the case), as well as withstand dusty, wet, and hot conditions, depending on where a set might be played using the pedal. The re-configuration will be done using a user interface found on a tablet or smartphone device. This UI application would ideally run on a device with above average quality hardware. The primary environmental factor to consider in regards to the UI would be potential rainfall during outside shows.

1.4 Intended Users and Uses

The pedalboard is intended for use by any musician. Professional or hobbyist, it doesn't matter. The application that controls the effects will be laid out in a simple and intuitive manner so that anyone can pick up this board and set it up how they wish. We want to allow total customization of the effects and allow the users to save their configurations

and map them to buttons on the board allowing quick transitions while playing. The board will be created with durability in mind. We want the user to be able to take the board to any venue they want. The board will be built to withstand a large number of button compressions and general use.

1.5 Assumptions and Limitations

Given the scope of the project, there would be a limitation as to the maximum quality of sound that would come from the pedal. The quality would be sufficient for most small-scale performances and for hobbyists, but may require a higher-quality chipset for use with very high-end concerts. Additionally, the pedal will have a certain number of effects available by default, but it is assumed that if a user has another pedal effect, they would be able to upload it to the pedal and use it similarly to any other effect.

1.6 Expected End Product and Deliverables

We will have two deliverables. Our first deliverable will be a pedalboard with 8-10 switches, most likely arranged in two rows on the board. There will be an LED display on the board to notify the user as to which effects are "on." Our second deliverable will be a user interface in the form of an app that can communicate with our pedal board with Bluetooth or Wi-Fi. The app will be where a user can configure the effects they want to use in series or parallel. They will also be able to adjust the parameters of a few select effects.

2. Specifications and Analysis

2.1 Proposed Design

There are several ways to allow re-configuration of effect sequences while in the middle of a live performance. A rather inefficient method would be to manually change the order and settings of physical pedals connected on stage. This would require a considerable amount of time to do, even if the change was a minor one. The alternative to this is to create a switching mechanism to do this on command. This could be done using either analog or digital technology.

2.2 Design Analysis

So far, we have gathered input from a group of surveys we had sent out. Taking the information from the surveys, we gathered research to implement the effects and features people wanted in our product. We have found a library of digital effects that we plan on including in our boards list of effects. Recently, we have acquired the Raspberry PIs and are planning on running tests within the next couple weeks. No extensive testing on a physical prototype has been conducted.

3 Testing and Implementation

3.1 Interface Specifications

We have not started any testing phases yet of our project since we haven't had the hardware to start prototype development. When we start developing the app, we will plan on using unit and mock testing to validate the apps UI and processes.

3.2 Hardware and software

We will be using the Raspberry Pi 3 which will be integrated into the pedalboard to control the effects being used. To control/change these effects produced by the Raspberry Pi, we will have it communicate with an iOS app over WiFi. The app will have an intuitive design that both hobbyists and professionals can make desired use out of. This app will have a field in which the user can drag and drop specific effects, shown as individual pedals, and specify the order or sequence in which they manipulate the sound signal. Whether the effects are put in sequence and/or in parallel, this design will provide the Raspberry Pi with the ability to create a large range of effects/tones.

3.3 Functional Testing

Functional testing will include the implementation of effects onto the raspberry pi, the communication between the pedal board and the app, and the successful manipulation of a live signal in real time. We will test the effects we found for the Raspberry Pi by using recordings of instruments and using either a small speaker or headphones to listen for the distinct way the final signal should sound. Testing the communication between the pedal board and the UI will consist of going back and forth between the two and debugging the app itself.

3.4 Non-Functional Testing

Testing for performance will occur intermittently throughout the project. Specific non-functional testing will consist of testing for sound delay or other unwanted sounds, and usability of the app.

3.5 Process

The sound signal type we chose to go with is digital and not analog. Digital effects are growing in popularity due to they're cheaper price and the fact that digital technology has gotten much better in the past few years. Blind tests show that digital effects are nearly indistinguishable from analog. This is our reasoning to this design decision. Using the Raspberry Pi, we plan on first getting the effect libraries to work with a digital signal and make sure the output is correct. Development of the app will be done concurrently with the development of the hardware to ensure they integrate easily and properly instead of forcing one to work with the other since commitment to one design has been made. After we get communication between the Raspberry Pi and the app and can change the active effects on the Raspberry Pi, we will begin integrating the system into a pedalboard which consists of a box frame and switches. These switches will be wired to the Raspberry Pi and indexed to the Pi's effect memory bank in order to change between the effects present on

the board at that moment. Testing will be done along the way of course, but after this final prototype step is complete, we will conduct thorough testing throughout the system to ensure system integrity.

3.6 Results

No testing has been implemented yet since we have recently obtained our Raspberry Pi's which are needed to begin development and testing.

4 Closing Material

4.1 Conclusion

Musicians need to be able to transition between effects, quickly and effortlessly, while playing a song in front of a live audience. The musician also requires a durable board that can withstand the pressure of a person depressing the buttons with their feet. The board should also be weather resistant to allow the musician to play at a variety of venues. We propose that we create a multi-effect pedalboard that can be preprogrammed with the artist's effects. This would allow the user the ability to create a board that is customized to their needs and allows for quick and easy transitions between the saved effects. An application will be created to allow the user to implement these effect configurations, while having a simple and intuitive layout for the user. When the board and the application work in tandem, the musician will have an effective tool for creating and transitioning between effects.

4.2 References

Raspberry Pi effect libraries:

Ray. "How to Start Programming Pedal-Pi." ElectroSmash, 27 Apr. 2017, www.electrosmash.com/forum/pedal-pi/202-how-to-start-programming-pedal-pi?lang=en.