Project Budget

Item	Total Price ($)
Computer Hardware	
(3x) Raspberry Pi Single-Board Computer Model B	105
(3x) Wolfson Audio Pi Sound Card	99
(2x) 3.5” Monitor Screen	90
(3x) Preamp Unit	120
Patch Cables/Adapters	40
(3x) Cases	55
Miscellaneous Hardware as Needed	125
Live Interface Hardware	
Input Hardware	450
(40x) Foot Pushbutton Switches	85
(over 50x) Nuts/Bolts	50
Indicator Electronics	20
(10x) Rotary Potentiometers	23
(6x) Analog-Digital Converters	45
Assorted Cables	65
(5x) Reducer Gears (probably nylon)	8
Aluminum Sheeting (estimated at10' x 1')	70
Structural Wood	25
Other Fasteners	20
Other Switches	35
(6x) Slide Potentiometers	24
Miscellaneous Electronic Components	150
Testing/Manufacturing Hardware	
(1x) Metal Shears	45
(1x) 21” HDMI Monitor	135
Other Fabrication Hardware	80
Known Shipping Costs	65
Est. Additional Shipping Costs	60
Grand Total	2089

Project Overview- Open Architecture Effects Unit

A suite of electronic effects are a critical part of the equipment of many electric guitarists and other performing musicians. There are currently two main options for responsive live effects- a traditional pedalboard of analog effects or a digital emulated pedalboard. Each has its drawbacks- the traditional analog pedalboard is inflexible- in order to add another effect, one must go buy a new effect pedal and patch it into the pedalboard. This can grow prohibitively expensive very quickly- building a new pedalboard can quickly run well in excess of $500. Also, this makes experimentation more difficult, taking not just additional money, but additional time and effort to add a new sound to the effects units. The second option, the digital pedalboard, improves on mainly this aspect- by modeling the analog effects in a digital space, new effects and new versions of effects can be created virtually and added in at will. This option is only starting to increase in popularity now as the community of musicians grows less wary of digital electronics. Still, the price of these devices is largely from $400 and up, which can be cause for reluctance considering the fast-evolving nature of digital electronics. Digital electronics become obsolete at an incredible rate- in three years, a digital system will often be outclassed in performance by four times. This rate has held steady for over forty years and shows no signs of slowing in the near future. Understandably, many musicians are leary of buying a system that will become outmoded in such a short time.

With those challenges in mind, my project aims to introduce a new class of digital effects unit, by taking the technology to its next level of abstraction. The full system will be comprised of a small computer running audio processing software, and a set of physical control switches, sliders, pedals, or any other of the myriad physical sensors available today. Audio will be processed through the computer, with the performer controlling the effects using their network of physical sensors. What will be developed here is a set of effects software and a hardware interface protocol to connect live controls to the effects unit. The strengths of this approach lie in its generality- this system will be a primarily software system. It will run on a computer running a standard operating system. The controls will be connected using a widely prevalent input standard. The software will be open and easily modifiable.

This approach addresses the main problems inherent in digital pedalboards and multi-effect units- the fast-approaching obscolescence of even the newest digital equipment, and, to a lesser degree, the high price point. By implementing an open, software-based format, an obsolete part of the system can be completely swapped out without changing the system itself. Instead of replacing an entire $450 digital effects system every few years (and, along with it, having to learn a new system of controls and effects management), a musician could buy a new $75 single-board computer, copy over the old files, and begin working with the same physical controls and effects system that they are already familiar with, but with vastly improved physical power- more detailed effects can now be handled. The system is upgraded with a minimum of expense, both in money and effort.

The system will be implemented using inexpensive, open small-scale computational resources which have recently become available: the Raspberry Pi single-board computer ($35, released 2012, now in its second revision) and its newly-released sound card ($33, released March), which provides it with full 24-bit 192-kHz audio input-output (a better standard than many PC sound cards). The Raspberry Pi will be running a variant of Debian, a well-known (and quite intutitive) open operating system with a long history and wide user base. The control systems will be designed to use USB, the world's most prevalent connector format.

In order to maximize the potential adaptability of the software, it will be based as much as possible on available open-source software- my current preference is to use the Pure Data processing engine with as few adaptations as possible. This engine has a number of desirable characteristics- it is designed to work on almost any operating system, over a wide range of hardware grades (It has been successfully used on the Raspberry Pi before). If this same portability can be maintained through my work, then the system could be transplanted over to a musican's home computer, where they could use

the same bank of live controls and same effects as they do in performance. Also, Pure Data is very well-known and has a long history, so there is a great volume of documentation on the engine, which should greatly streamline its implementation.

As the engine I will be building the project on will require very little work to implement, most of the work I will be doing will be in building the controllers and the controller standard- the aim being to create pieces which will demonstrate to as many varieties of live musicians the flexibility behind a software-based effects system. To this end, I plan to spend a significant portion of the time during the design stages of the project interviewing a large variety of musicians, aiming to find out what capabilities they would like to have while performing that they currently do not. Once I have assembled a significant sample of responses, I would begin working on a control system and matching set of patches for the Pure Data engine to deliver the tools which are most demanded by the musicians.

To address a few of the figures on the budget- the core components are tripled. This is for multiple purposes: having two devices which can be made identical is a highly useful tool for debugging, also, later in the project, I intend to lend out units for testing by other musicians (possibly for an extended length of time). With just a single unit, work would come to a halt during this testing. With multiple units, each unit can be also configured differently, to run comparisons for optimizing different parts of the system. Finally, one of the aims of the project is to make these units useful to any musician performing live- it would be an ideal demonstration of concept if multiple musicians in a group were able to perform with their own unit, each using it in a different way. A large portion of the Live Interface budget section is left unallocated (“Input Hardware”). This is due to the way in which I plan to conduct the project- I have plans to build a few varieties of controller, but most of the designs will be based on the needs of musicians that I interview, so, I cannot predict ahead of time what sort of sensors I will need. This is seperate from “Miscellaneous Electronic Components”- this section of the budget covers electronic parts which are needed due to unforseen technical issues (in my experience building electronics, this is always a significant expense with every new electronic design).

Finally, to adress how this project will be presented upon completion- The presentation will be a demonstration of the unit. The process of development could be shown by demonstrating the operation of the different builds that were used in testing (as the project progresses, I will save versions of the project as they were at the time). With the very large amount of time I have allocated for testing, I expect to have some (if not all) of the versions of the unit go through absolutely drastic revisions throughout the testing process. As one of the main aims of the project is to produce a tool that is highly versatile, I would like to make the performances used to demonstrate the unit as spontaneous as possible- I am considering introducing random constraints (i.e. rolling dice to chose an instrument) into these performances in order to demonstrate an ability for the system to be readily adapted along with the performer. However, this is subject to change, as the nature of the equipment to be built will not be determined until the project is well under way. Due to the similar nature of the grant project which I will be presenting later this month (the Variable Undertone Effect), I plan to use what I will learn from that presentation in the presentation of this effects platform.

Evidence of Participation in the Arts:

I am/was part of the following ensembles:

- -Marching Band (2011-)
  - +On Recording Crew (tasked with setting up microphones and production)
  - +Playing Tuba
- -Klezmer Ensemble (2012-)
  - +Playing Clarinets (Soprano, Alto, Bass), Tenor Saxophone
- -Wind Ensemble (2011-2012)
  - +Playing Clarinet (Soprano, Alto)
- -Charlottesville and University Symphony Orchestra (2011)
  - +Playing Clarinets (Bb and Eb Soprano, Bass), Tenor Saxophone
- -9 AM Choir, Saint Thomas Acquinas Parish (2012-)

While at UVA, I have composed and produced soundtracks for "The Problem with Route 29-" (a documentary film by T. Ryan Yowell, ARCH '13), and a few short films. As a personal project, I have produced a large amount of experimental electronic and electro-acoustic music (some of which is included with this application).

I have taken both MUSI 3050 (Music and Discourse Since 1900) and MUSI 3010 (Studies in Early Modern Music), and am currently taking MUSI 3320 (Theory II).

In the Arts Scholars program: I have attended all the seminars from my first year onward. I ran sound design for the Arts Scholars Showcase during Fall 2013.