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January 22, 2010

Dr. Andrew Rawicz
School of Engineering Science
Simon Fraser University
Burnaby, British Columbia
V5A 1S6

Re: ENSC 440 Project Proposal for an Electric Guitar Effects Combiner

Dear Dr. Rawicz,

The attached document, *Proposal for an Electric Guitar Effects Combiner*, outlines our project for ENSC 440 (Capstone Engineering Science Project). This project is set to make combining the effects of an electric guitar for a professional guitar player easier and more efficient.

This document provides an overview of our proposed project, some possible design solutions including our proposed design solution, sources of information, a tentative budget including our sources of funds and a proposed schedule for the completion of project milestones. Also, a section discussing our team's organizational structure, members' roles and background information has been included.

Musictronics team is established by three innovative and passionate engineers: Kianoush Nesvaderani, Amanueal Heilegio, and myself, Gondang Prabowo Yudo. If you have any questions or concerns about our proposal, please feel free to contact me by e-mail at gpy1@sfu.ca.

Sincerely,

Gondang Prabowo Yudo
President and CEO
Musictronics

Proposal for

Electric Guitar Effects Combiner

Project Team: Gondang Prabowo Yudo
Kianoush Nesvaderani
Amanueal Hailegiorgis

Submitted To: Dr. Andrew Rawicz
Dr. Steve Whitmore

Contact Person: Gondang Prabowo Yudo
gpy1@sfu.ca

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Executive Summary

For a professional guitarist or burgeoning amateur trying to make it, the best kinds of effects to use are the stompboxes effects. Why? They are easy to use, a lot of variation, sounds amazing, and cheap. And since the stompboxes comes in many different types (distortions, flanger, pitch shifting, etc) it is very common for a guitarist to possess more than 6 stompboxes pedals. This becomes a problem in live performances. Especially if you have to turn on multiple stompbox effects in combination to get a certain tone.

To alleviate this issue we decide to design a device that can combine the stompboxes using digital signal switching. We are going to implement the switching mechanism in FPGA board and thus the whole system will be digital and operating close to real time. The device would also have the ability to combine multiple stompbox effect in a single step, eliminating the need for guitarist to multitask during live performances.

Current technologies for combining stompboxes effects are inflexible and impractical. On solution is to get the Morley ABY switch. This switch allows you create 2 different stompbox effect loops. And it is clear that the limitation on this device is the amount of effect combination it can produce. Another solution is to buy a multi-effect devices (BOSS GT-10, Line 6, etc), but this solution has several drawbacks. One is the drop in sound quality since its well documented that multi effect produces a “weaker” output thann the stompboxes. Another drawback is the cost, to buy a really good multi-effect devices can cost up to $3000.

Musictronic consist of 3 4th and 5th year students from SFU with different technical background as well as experience. We have considerable knowledge in Hardware Design, Software design, as well as Real-Time System to successfully design and Integrate the Device. The proposed project has an overall budget of $903.A detailed 13 week schedule has been constructed with April 9th as the proposed date for completion.

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1.0 Introduction

For a professional electric guitar player, combining the effects is the most challenging task while playing. Stepping on different pedals in order to get the crisp professional sound is not only a challenging process but it could also be frustrating and energy consuming at the same time. It has always been hard for a human being to multi task at the same time. Likewise for a guitar player, focusing on both playing and effect combining is simply challenging and hard. Although for the past few years, there have been some products that can help combining effects digitally; there is still a need for a combiner that can help professional players, specifically, to combine analogue effects in order to reach to a crisper and heavier sound.

Our product, *Electric Guitar Effects Combiner* aka *The Combinator,* is designed to combine the analogue effects on one single box. With preset buttons on the box, the player has the option to combine any kind of effects by just pressing the buttons and play the guitar with the required effects. While our product makes it easier for the guitar player to control and combine the effects, it also helps the stompboxes' life cycle as with no more stepping on the pedals, the stompboxes' pedals wear out in a much longer time frame.

This proposal is focused to provide an overview of our vision along with the product's proposed design, budget and funding, and the schedule required to reach to the finished product. The schedule references are provided, which show the time frame needed for each task to be completed. We believe our final product is innovative yet helpful and revolutionary in the electric guitar industry.

2.0 System Overview

Our design solution to simplify the method of combining these "Stompboxes" effects is to design a device that can route the guitar electric signal into the individual stompboxes by means of switches. To properly illustrate the idea, figure 1 below shows the interface of "The Combinator". The device can house 4 stompboxes as well as 4 different (user defined) presets combinations of the stompboxes. The small switches on top of the preset buttons represent the individual stompboxes. For example for preset number 1 the FX switches that is activated is the 1st and the 3rd, so if you press the preset 1 button the output will combine the Equalizer and Delay.

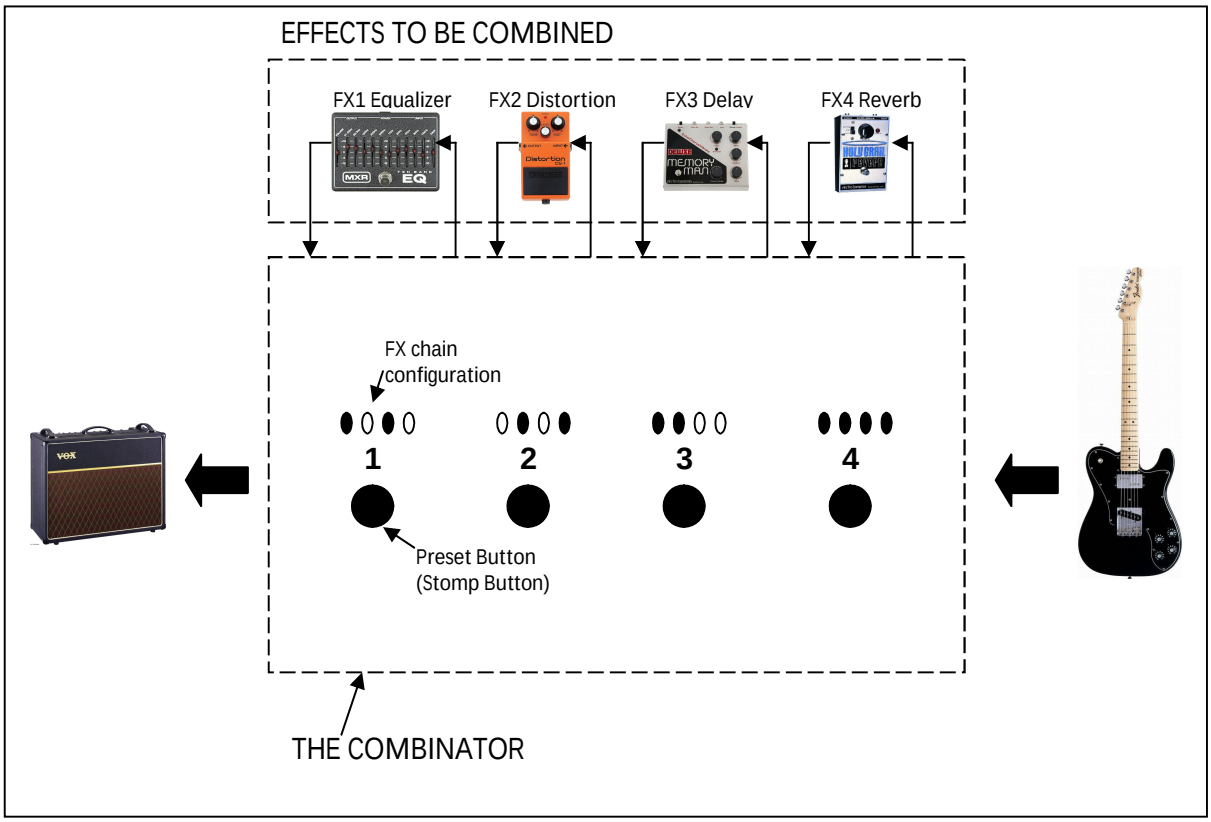

Figure 1 – The Combinator Interface

3.0 Possible Design Solutions

This section introduces some of the technology that is currently used for an electric guitar's effects combining. There are two products in the market that have been designed to combine effects: Morley ABY Selector/Combiner, and Multi-effects (Multi-FX) Devices.

Morley ABY Selector/Combiner:

This device routs one signal to two outputs or two inputs into one output. The limit of this combiner is only about two signals, A and B. It can choose A, B, or A & B combined. The LED on each letter shows which signal is active. The combiner is a passive unit, which means it can work without battery. However, only one 9 volt battery is required for the LEDs to flash. Finally, this device has dimensions of 5.25" (L) x 3.25" (W) x 2" (H). [1]

Multi-Effects (Multi-FX) Devices:

A multi-effects device is a single pedal or rackmount device that can combine many electronic effects. Zoom and Korg are the well known names between the producers of such devices. Multi-FX devices provide users with many "preset" combinations of effects including: distortion, chorus, reverb, compression, and so on. The whole process helps the musician to have quick access to on-stage effects while playing live. However, the output sound of the multi-effects is not as "thick" as stompboxes' output. [2]

4.0 Proposed Design Solutions

Figure 2 will give a more detail illustration of the system inside the device. The way the device combines the stompboxes is by designing a digital switching circuit in FPGA board to route the path of the electric signal from the guitar through the effects we designate. Every stompbox connected to the device has its own individual signal loop activated by a switch and in doing so we ensure that the effects are isolated. In addition since every stompbox has its own loop and switches, we can construct the presets by connecting the switches with a control circuit giving the user flexibility and ability to store multiple combinations of stompbox chain.

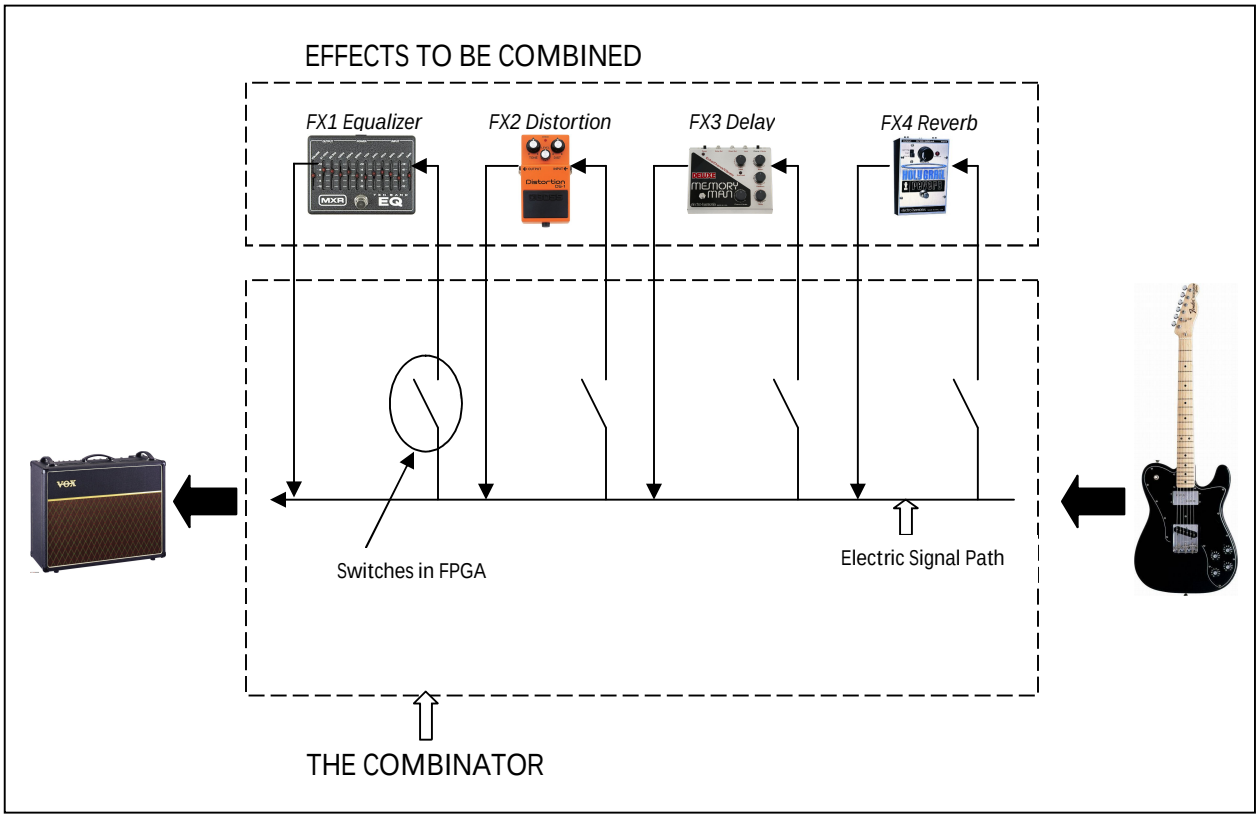

Figure 2 – Inside the Combinator

5.0 Sources of Information

Our methods in acquiring useful information for the design solution of our device we make use of sources such as the internet, previous course textbooks as well as consulting with professors. We consulted with Dr. Lakshman One (Expert is circuit design) and Dr. Lesley Shannon (expert in hardware computer design) to get a clearer idea of how we should approach our design.

6.0 Budget and Funding

6.1 Budget

Table 1 shows the tentative budget. Each item has been overestimated by 10% for contingencies.

Table 1 – Tentative Budget

Equipment List	Estimated Unit Cost
FPGA Board	$270 x 2 = $540
3.5 mm Mono Plug (10 per Package)	$13
Prototyping Breadboard	$40
Latching Stomp Switch	$10 x 4 = $40
σΔ ADC	$6 x 10 = $60
σΔ DAC	$6 x 10 = $60
Casing	$50
Miscellaneous	$100
	Total Cost: $903

6.2 Funding

Due to the fact that our group was formed later on the second week of classes, we were unable to apply for ESSS funding. However, as the major part of our costs goes to the two FPGA boards, we are currently planning to borrow the boards from the school. If we fail to do so, the members of the group have agreed to individually contribute some funds in order to provide all the items needed.

7.0 Schedule

The Gantt chart on Table 2 shows the proposed schedule for completion of various projects.

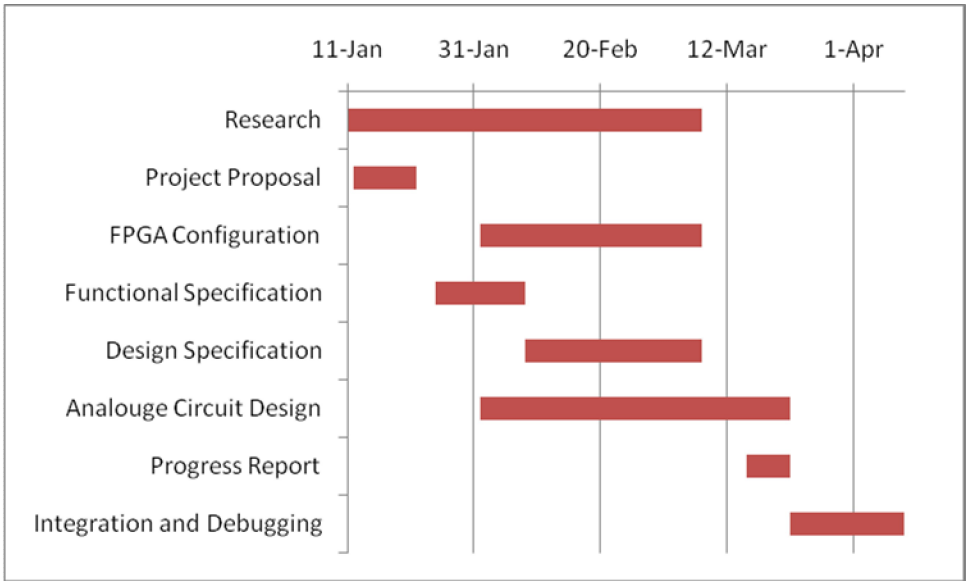

Table 2

The following table also shows the completion date for specific tasks. The tasks italicized are in the format of documents that need to be submitted.

Task	**Completion Date**
Research	March 8, 2010
Project Proposal	January 22, 2010
FPGA Configuration	March 8, 2010
Functional Specification	February 8, 2010
Design Specification	March 8, 2010
Analogue Circuit Design	March 22, 2010
Progress Report	March 22, 2010
Integration and Debugging	April 9, 2010

Table 3

8.0 Team Organization

Our team is formed around three innovative engineers: Gondang Prabowo Yudo, Kianoush Nesvaderani, and Amanueal Heilegio. All members are fourth year engineering students at Simon Fraser University. However, each member brings a different aspect of perspective and expertise forming a fully dynamic and creative team. Each member's role with the organization as well as their expertise and experience are outlined in the section, Company Profile.

For a small team like ours, it is important to define roles for each member. Gondang Prabowo Yudo (CEO) is responsible for making final decisions and managing the whole process. Kianoush Nesvaderani (CFO) is responsible for funding acquisition and budget planning; besides, he is in charge of scheduling and overseeing the daily operations. Finally, Amanueal Heilegio (CTO) is responsible for technical operations of the organization.

Email, telephone, and group meetings are the ways our team members communicate within the whole organization. In order to manage our time properly, meetings are organized based on our needs. Before each meeting, an agenda is prepared in order to know the exact criteria and save most of the time. Meeting minutes are also taken regularly during the meetings, so we can have track of all our discussions and decisions.

The tasks of this project have been divided into two main categories: FPGA Configuration and Analogue Circuit Design. The following table shows each members contribution into each task.

Project Task	Gondang	Kianoush	Amanueal
FPGA Configuration	✓		✓
Analogue Circuit Design		✓	

Table 4

Although, based on table 4, only one person is going to be involved in the analougue circuit design, all the members are going to help each other in all the tasks. Due to the fact that our team is only formed of three members, we realize that all of us need to be involved during the whole process. However, each member still has a specific task he needs to fulfill.

9.0 Company Profile

Gondang Prabowo Yudo – Chief Executive Officer (CEO)
I am a 4th year student at Simon Fraser University majoring in Electronics Engineering. I have taken many courses in analog and digital circuit design which allowed me to be familiar with circuit design. I also have considerable knowledge in VHDL programming on an FPGA. Moreover I am also a guitarist and music enthusiast which bode well for the project.

Amanueal Hailegiorgis – Chief Technological Officer (CTO)
I am a fifth year Systems Engineering student at Simon Fraser University. I have completed one co-op semesters working on automation product at Embedded Automation. This experience has enhanced my comprehensive knowledge of computer and embedded systems. My skill set include both software and hardware, I am a competent in programming in C++, Java, Matlab, VHDL. Moreover, through various lab projects, I have developed a strong team skill. As Chief Technology Officer, I will be in charge of research and development of new technologies.

Kianoush Nesvaderani – Chief Financial Officer (CFO)
I am a fourth year Systems Engineering student at Simon Fraser University with previous co-op term working experience on banking databases, database spreadsheets, and online database websites. During the course of my work term, I gained experience in creating, programming, and updating EXCEL based spreadsheets and databases. I have taken courses in Microelectronics, Digital Signal Processing, Feedback Control System, Manufacturing Aided Design, Actuators and Sensors, and Robotics. These courses have allowed me to complete projects designing robotic simulations in Open-GL and testing them using Haptic technology. They have also allowed me gain experience designing circuits and robotic systems.

10.0 Conclusion

Combining and switching effects for an electric guitar is not a new concept. However, due to the fact that multi-tasking is hard for a human being at all times, using stompboxes and stepping on pedals while playing is the most challenging part for a professional guitar player. Our team is dedicated to overcome this issue with a product that is easy to use and time efficient.

The Electric Guitar Effects Combiner gives the ultimate option to the guitar player to choose his/her effects by just pressing some preset buttons. In which case, the player can have all the needed effects while playing without stepping on any pedals.

Our team is confident to finish this project within the time frame provided on the Gantt chart and the milestone table. Our schedule, budget, and team organization have been presented to show our team members' expertise, experience, and ability to finish this project within our time frame and budget.

11.0 References

[1] “Morley Pedals” Retrieved on January 18, 2010 from
http://www.morleypedals.com/daby.html

[2] “Wikipedia”. Retrieved on January 18, 2010
from http://en.wikipedia.org/wiki/Effects_unit