Muğla Sıtkı Koçman University

Department of Computer Engineering

Senior Design Project II

3-Band-Eq (FineTune)

Analysis & Design Report

Jonathan Barış Yaprak

Supervisor: Zeynep Filiz Eren

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3-Band-Eq

1 Introduction

The 3-Band-Eq is a Equalizer made specifically for music production. It is optimized for situations where the musician needs a quick fix for their audio while saving memory for other audio effects in their studio session.

2 Motivation

In the last 5 years while producing, mixing and mastering music, I have faced countless occasions where I needed to apply a very quick cut or boost to my audio but the equalizer applications I were using would take up an unnecessary amount of memory for the simple task. That sometimes resulted with me not being able to use other audio effects that I needed later on in the studio session due to not having enough memory left. That would force me to calculate the memory I was using during the studio session instead of just focusing on the production. I wanted to create an equalizer that is optimized for music production with a low memory consumption and a user friendly UI.

3 Similar Existing Applications

Applications similar to the **3-Band-Eq** are the **FG-S**(1) by Slate Digital and the **Fruity Parametric Eq**(2) by Image-Line. Just like 3-Band-Eq, these two applications are both equalizers. Slate Digitals FG-S is used in all areas that require audio engineering. It is used in music production, film production, podcasts, live shows and many more areas. It has 5 filters that each apply to a specific frequency range of the input audio. It's user interface is quite complicated and not very user friendly. On the other hand, the Fruity Parametric Eq is optimized for and mostly used in music production. It has 7 filters that can be applied to any frequency from 10Hz to 16,000Hz. Unlike the FG-S, it has a much more user friendly interface.

The 3-Band-Eq is similar to the Fruity Parametric Eq in the sence that it is user friendly and optimized for music production. Allthough more filters means more control over the input audio, it also means that more memory is being used. This can be a problem because the musician not only needs an equalizer but they need multiple effects, like reverb, delay, distortion and many more. And they need to apply these effects to each instrument in the studio session. This can be very memory consuming. Musicians don't always need that much control over the audio. In those cases, the 3-Band-Eq can be used to apply a basic filter the audio while saving memory for other effects in the studio session. The 3 filters of the 3-Band-Eq can also be applied to any frequency. But the frequency range is 20Hz-20,000Hz compared to the fruity Parametric Eq's 10Hz-16,000Hz. This gives it a wider range while also excluding the unnecessary 10Hz-20Hz range which can't be percieved by the human ear.

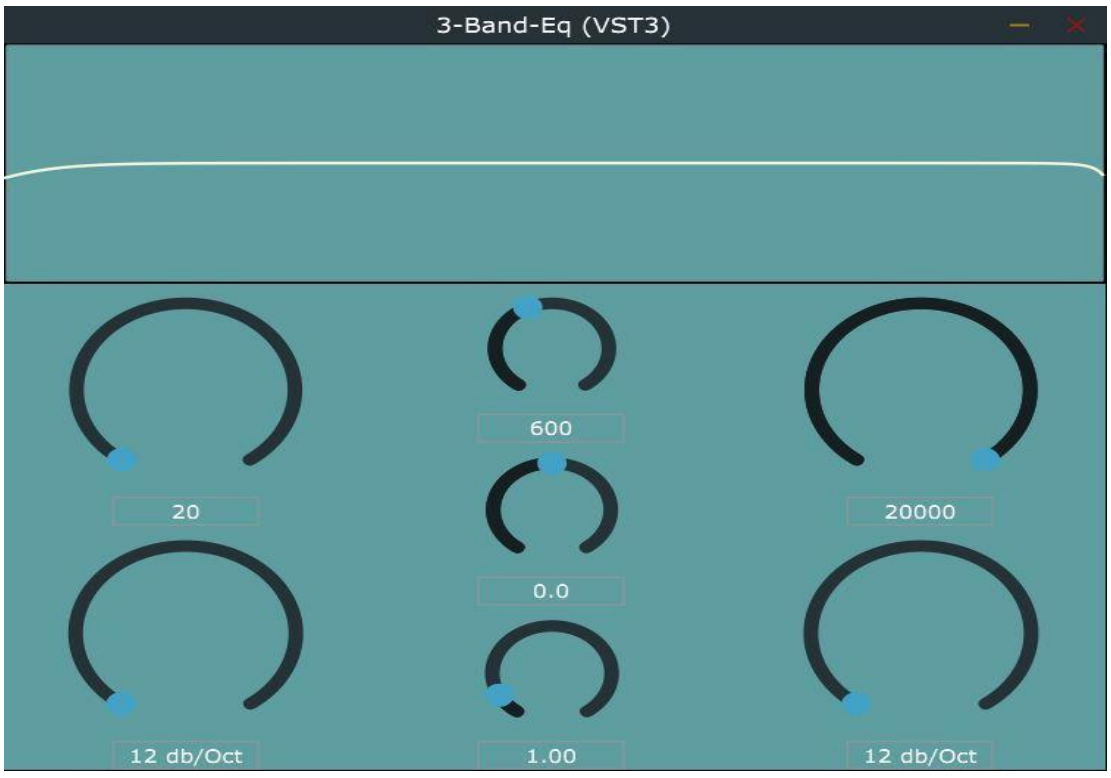
	Number of Filters	Response Curve	Optimized for Music Production	Free Filters	Covered Freq Range
FG-S	5	X	X	X	0Hz-16,000Hz
Fruity Parametric Eq	7	✓	✓	✓	10Hz-16,000Hz
3-Band-Eq	3	✓	✓	✓	20Hz-20,000Hz

4 Proposed System

4.1 Overview

The 3-Band-Eq makes use of 3 **Infinite Impulse Response (IIR) filters**(3). An IIR filter is a filter that can remove volume from or add volume to a selected frequency range. Another filter type is the Finite Impulse Response (FIR) filter(4) which produces better sound quality than an IIR filter. But the IIR filter was used because it is much faster, and the user of this application needs the filter to be applied to the audio in real time. Even though the FIR filter produces better quality, in the case of this application the difference in that quality isn't significant enough to use an FIR filter over an IIR filter.

C++ was used to create the application since it needed to work in real time. Also there is a great framework named **JUCE**, used to create audio applications with Digital Signal Processing(DSP). JUCE let's the developer use DSP components like reverb, delay, chorus and in this case filters.



The 3-Band-Eq has 7 knobs that each control a specific parameter of the audio. The knobs are devided into 3 ranges: **Bass**, **Mid** and **Highs**. The bass and high filters have 2 parameters each: **Freqcuency** and **Slope**. The mid range has 3 parameters: **Frequency**, **Gain** and **Quality**.

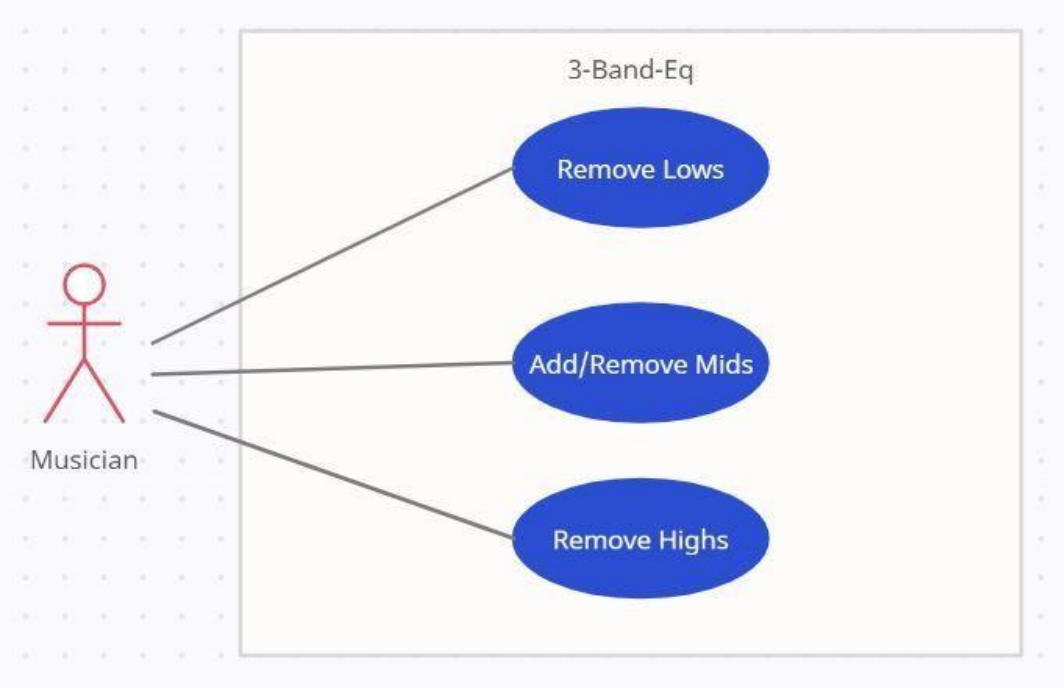
Frequency: Adjusts the filters applied frequency. (Hertz)

Gain: Adjusts the volume of the selected frequency. (Decibel)

Slope: Adjusts the 'harshness' of the filter. (Decibels per Octave)

Each adjustment is represented on the **response curve** and the parameters are restored to default values when the knob is double clicked.

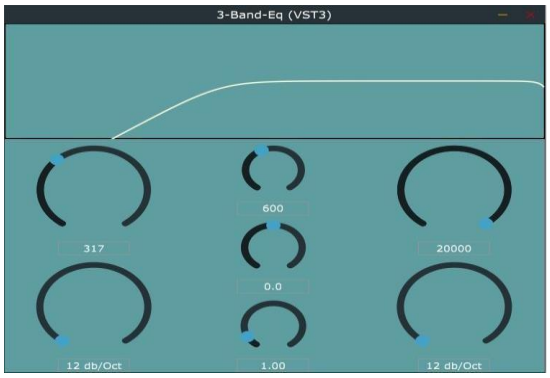
4.2 Use Cases



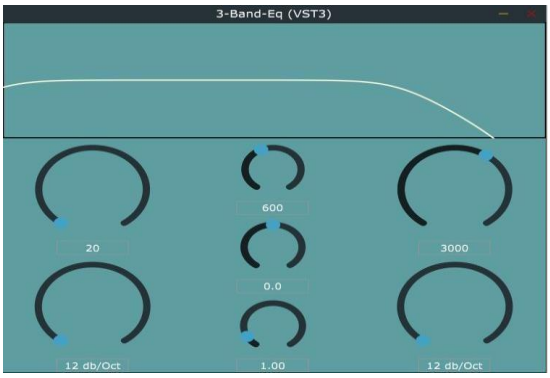
The 3-Band-Eq is designed for a very specific task which is to adjust the volume of selected frequencies. So it doesn't have many use cases besides changing the three different frequency ranges.

4.3 User Interface Design

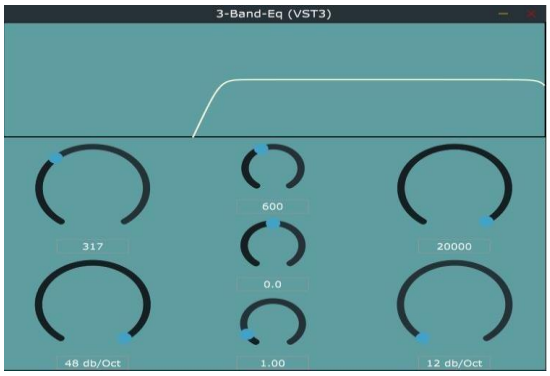
The UI is designed to be simplistic and easy to use with a very specific task in mind. Which is to apply filtering to the audio. Here are the filters that can be created with the 3-Band-Eq.



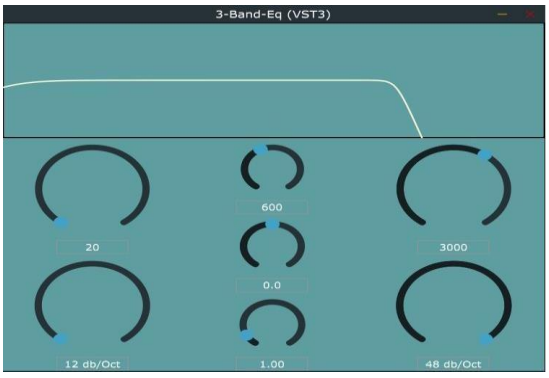
Gradual Low-Cut



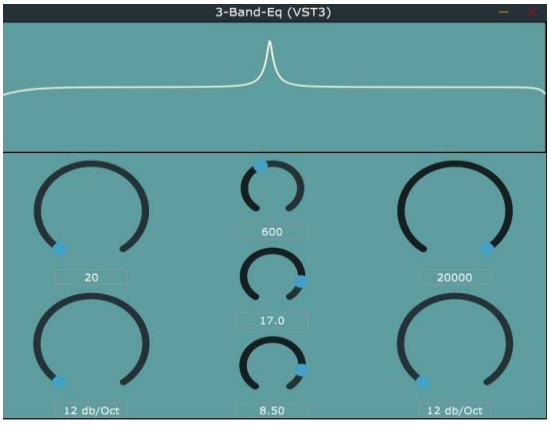
Gradual High-Cut



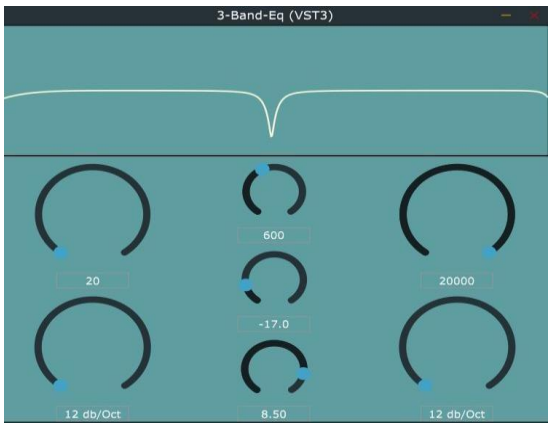
Steep Low-Cut



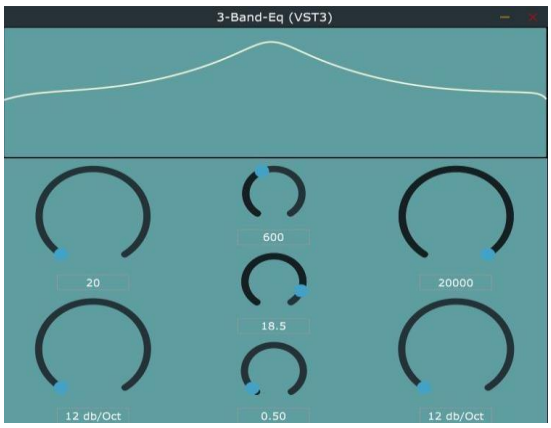
Steep High-Cut



Narrow Boost

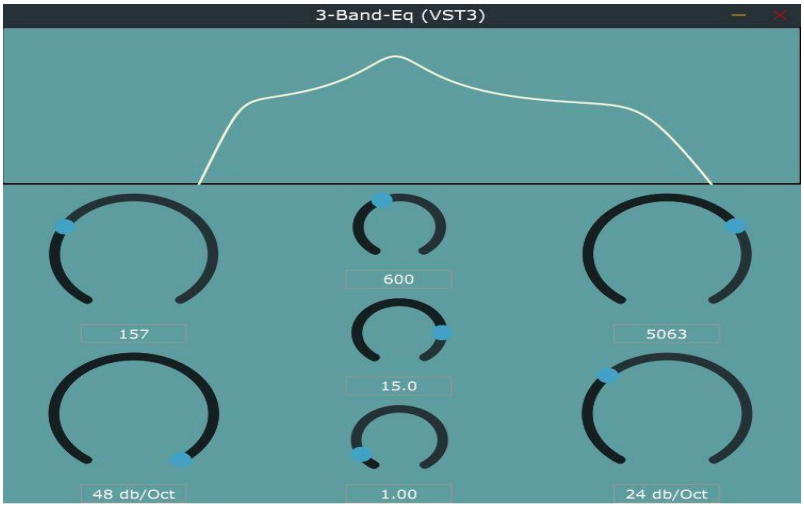


Narrow Cut



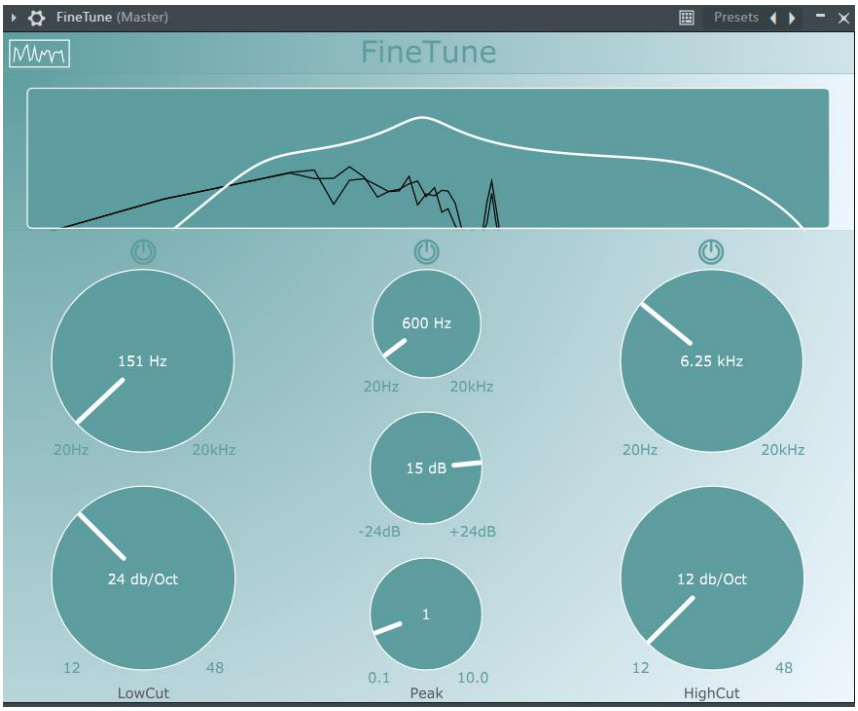
Wide Boost

Wide Cut

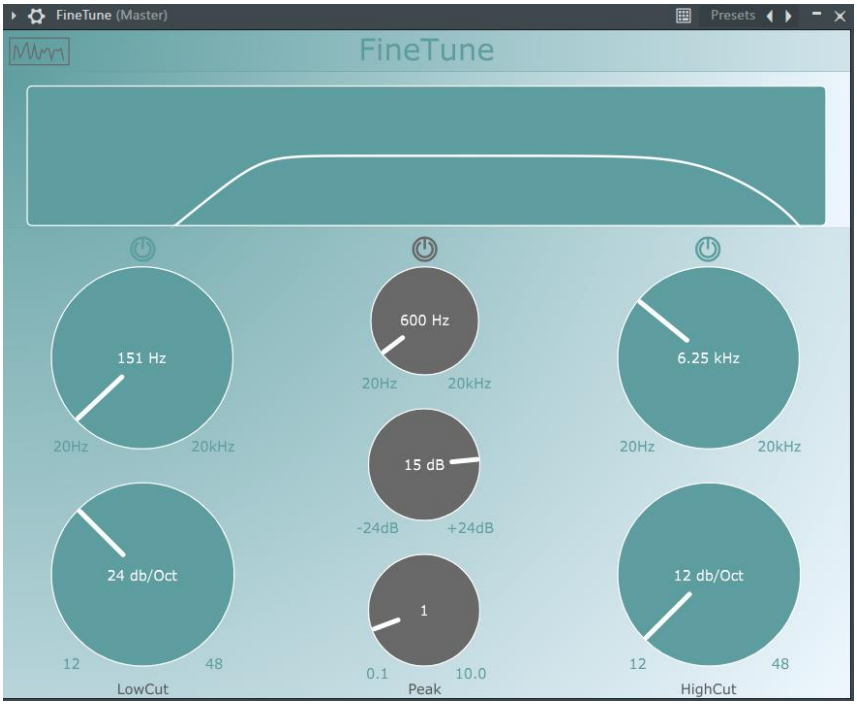


All three filters applied at once (Low and High Cut with a boost in the mid frequencies)

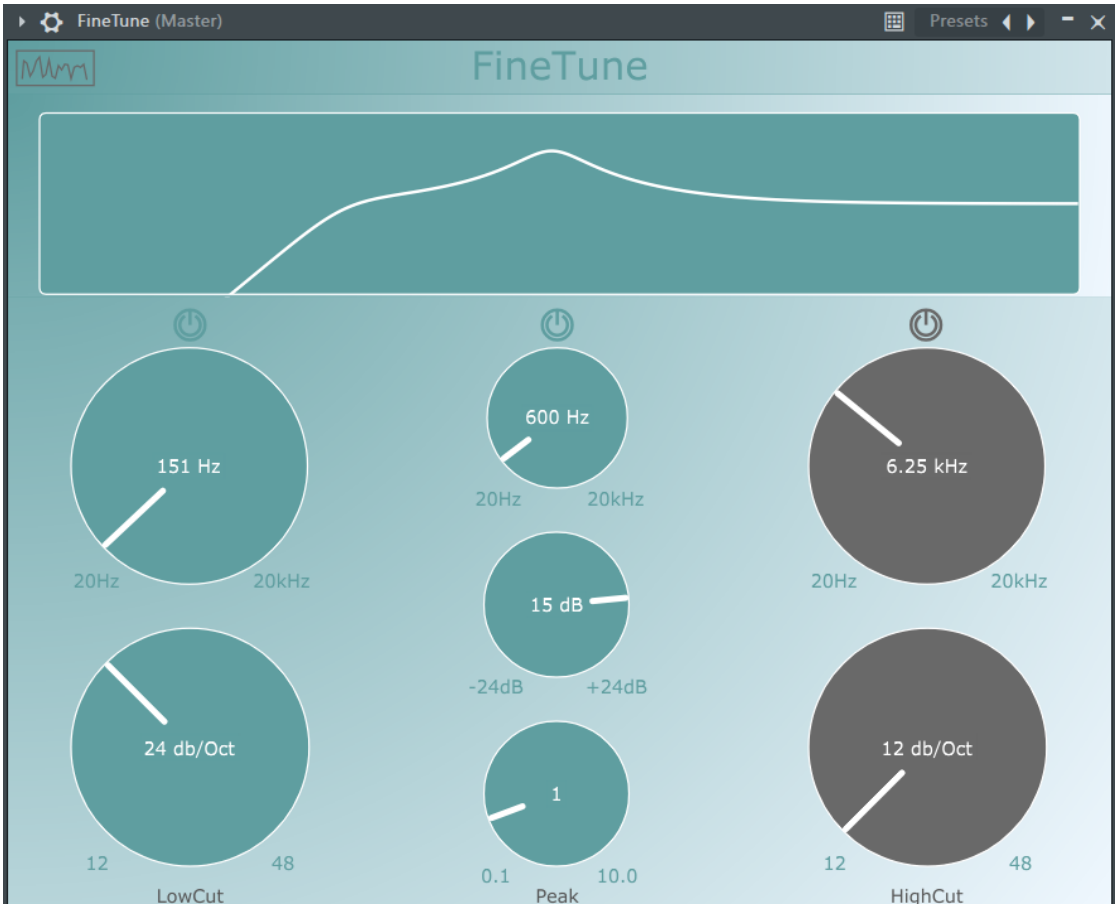
The GUI was later updated to look a bit more modern. A black spectrum analyzer(5) was added in order to display the real-time input audio for the user to be able to visually see the frequencies they are currently boosting/cutting, or the frequencies that they need to boost/cut. 4 buttons were added, 3 that enable and disable the corresponding frequency bands and 1 that enables/disables the analyzer. The three buttons allow the user to compare their input audio to their edited audio. The analyzer button is for the users preference, in case they don't want to see the visualized input audio they can turn the spectrum analyzer off. The name of the equalizer was also changed to 'FineTune'. The update GUI of 'FineTune' can be seen below.



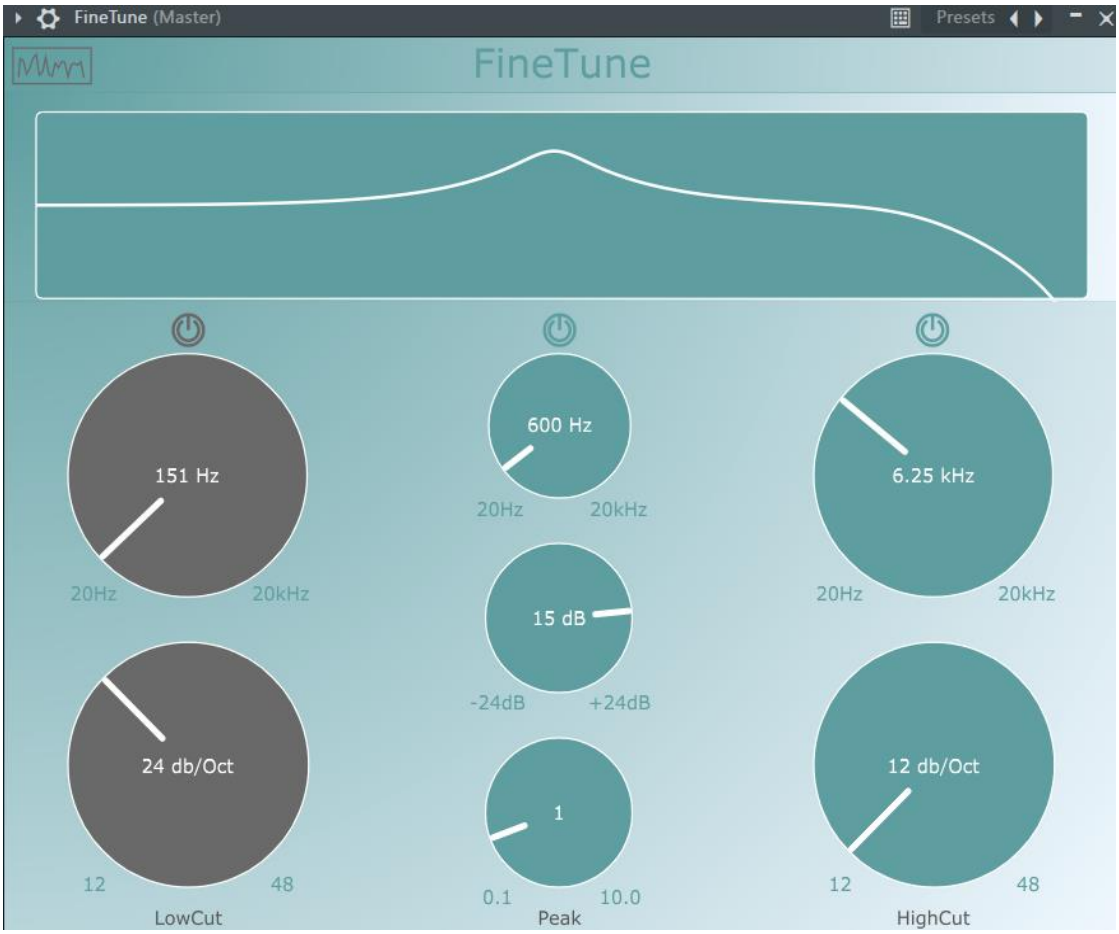
The three 'power' buttons above each bands parameters allow the user turn on/off the corresponding band. The analyzer button is the white button in the top left of the app. Here is what the interface looks like when these buttons are used:



Mid frequencies disabled.



High frequencies disabled.



Low frequencies disabled.

All frequencies disabled.

The corresponding frequency parameters will turn gray when one of the 'Disable' buttons are pressed in order to indicate that the frequency band is currently disabled. When the band is enabled again, the colors of the parameters return to the original colors to indicate that the band is currently enabled. Disabled frequency bands have no effect on the input audio. This lets the user to quickly go back and forth between the input audio and the edited audio to see and hear the changes that they are making to each frequency.

4.4 Technologies and Tools

C++, the JUCE framework and Digital Signal Processing was used in the project.

5 Future Work

In the future, the ability to save parameter settings could be added. This would let the user save their current parameter settings and use those settings in a separate instance of FineTune.

6 References

1) https://www.pluginboutique.com/articles/543

2) https://www.image-line.com/fl-studio-learning/fl-studio-online-manual/html/plugins/Fruity%20Parametric%20EQ.htm

3) https://docs.juce.com/master/classIIRFilter.html

4) https://docs.juce.com/master/classdsp_1_1FIR_1_1Filter.html

5) https://docs.juce.com/master/tutorial_spectrum_analyser.html