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# LAB 4

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## Different Music Analysis

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Time Frame – April 29

## Report Summary

This report represents the basic concepts and ideas implemented in the Music Analysis project. It looks into the different features of Music Analysis and how each of the parts are implemented. Along with the briefing of the project the report investigates the note detection algorithm in detail.

## Project Description

In this project there are different music analysis components and the user can switch from one to the other with the help of the launch pad buttons on either side of the launchpad. The components are: FFT Visualizer, a metronome and a note detector. The FFT in the project is implemented at 2048Hz. The project stays on the FFT screen until the buttons are toggled. The toggle between the different components is achieved by using an FSM. The below figure describes the working of the FSM.

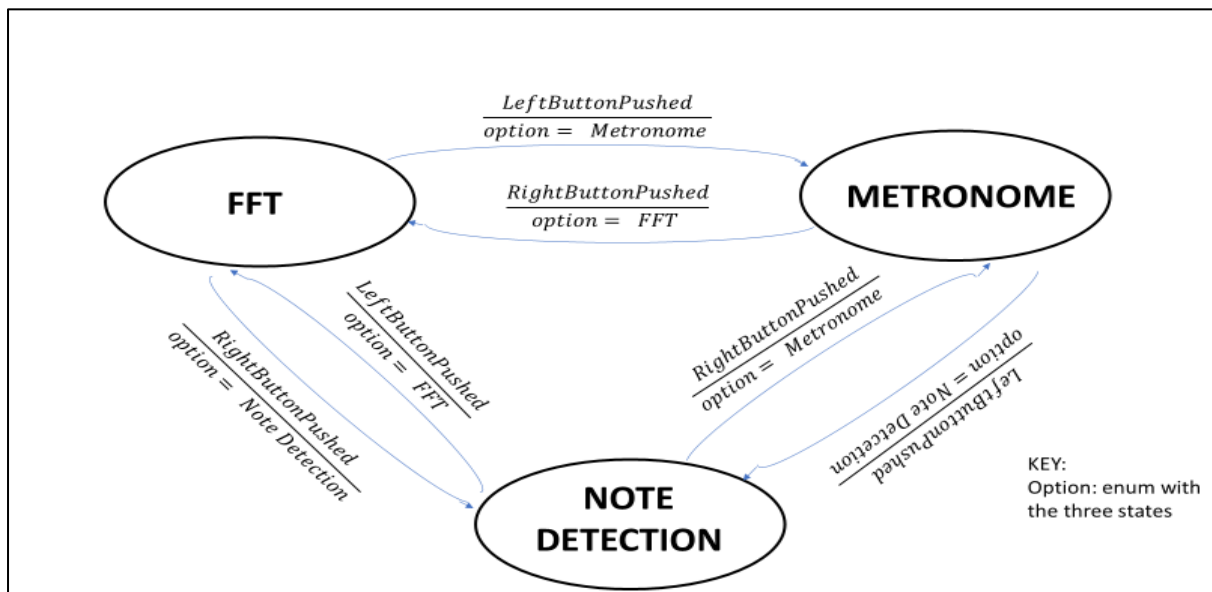


Figure 1: Music Analysis FSM

The metronome starts with initial beats per minute (BPM) of 100 and uses the booster pack buttons to increase or decrease by 10BPM. The lowest BPM that can be played by the metronome is 10 and the highest is 200BPM

## Note Detection Algorithm

The note detection algorithm in the project works with the help of the FFT. the note detection runs the FFT each time the method is called, and the max Index value is obtained. With the help of the max index value the following math is done to obtain the frequency, as the max Index value is scaled on a 4KHz scale which is divided into 512 sub units.

```
maxIndex = (maxIndex * 4000) / 512;
```

```
maxIndex = maxIndex + (4000 / (1024)); //this result gives the frequency  
detected by the microphone
```

```
if(maxIndex is between 127 and 140)
```

```
    print C3
```

```
else if(check for the next bandwidth)
```

```
    print D3
```

Continue the same way for the rest of the notes.

The math is for when the FFT runs at 2048Hz. After the max Index is modified and the actual value is obtained it is checked against the various frequency of the notes. When the max index falls under a specific bath width of frequency the corresponding note is printed.

## **Bonus Features**

Tuner: For the note detection, a tuner is implemented. So, when the user is playing a frequency which is slightly above or below the ideal frequency bandwidth the display states whether it is 'FLAT', 'SHARP' or 'TUNE'

For the Note detection, a lower octave, C3, is also implemented as well as all the sharps from C4 through B6 is implemented.

For the FFT, the frequency is changed from 512 to 2048 and the changes are made to the graphics also.