A Memorandum

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**Subject:** Written Progress Report 1

This project is to build a guitar tuner for an acoustic guitar. The device receives an audio signal from a guitar that is sounding only one note, and displays the fundamental frequency of the note being played. The tuner is to be microphone based, as opposed to the clip-on versions that mount on to the instrument. The tuner will calculate and display the fundamental frequency. The following table displays the functional blocks.

**Table 1: Functional blocks of guitar tuner**

|  |  |
| --- | --- |
| Functional blocks of device | Description |
| Power | Provides appropriate power to each subcircuit of device. |
| Mechanical acoustic wave detection | Detect mechanical acoustic wave, translating it into an electrical signal. |
| Signal conditioning | Amplify signal with filtering for data acquisition. |
| Data acquisition | Translate electrical signal to digital for analysis. |
| Data analysis | Analyze digital signal to identify fundamental frequency. |
| User interface | Display results of data analysis to user. |

**Power**

The guitar tuner will be powered by a battery, possibly 9V. The voltage is higher than needed so a buck converter will be needed to change the DC voltage to the specified 5V. If the microprocessor being used for digital analysis requires a lower voltage than this with minimal ripple, then a low dropout voltage regulator may be used in addition in order to have appropriate voltage.

**Mechanical Acoustic Wave Detection**

The condenser microphone circuit accurate detects mechanical waves produced by the car and has been tested. The signal is in the range of 30mV - 100mV depending on the intensity of the vibration of the guitar string and the distance from string to the guitar.

**Signal Conditioning**

In order for the signal to be converted to a digital one with minimal error, the electrical output of the microphone must be amplified. Also, the highest note on the guitar for standard tuning that will be approximately 400 Hz (enough above standard high e string which is 323 Hz for tuning purposes), so filtering is needed as well. The low-pass active filter will be built based on sallen-key topology and have at least two second order stages to attain appropriate attenuation of higher frequencies.

**Data Acquisition**

Converting the analog electrical signal to a digital one requires the use of an ADC. Many microcontrollers have this as a built in function so a seperate one may not be needed.

**Data Analysis**

Once the signal is in digital form, digital signal processing will be used to detect the fundamental frequency. A written MATLAB script has been written that uses autocorrelation to detect the fundamental frequency. This can be implemented in C programming which will be flashed to a microcontroller.

**User Interface**

Code will be written to interface an LCD with the microcontroller. The fundamental frequency of the guitar note being played will be displayed on the LCD.



**Figure 1: Fundamental block diagram of guitar tuner**