Instant Guitar Chord Maker

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Introduction

As far as we know, there are two basic ways to make a guitar tutorial nowadays. One is to set up multiple cameras by a guitar player. This provides viewers a good understanding on chords and pluck/pick techniques. The second way is to record the audio of guitar and use softwares to demonstrate the techniques afterwards. Both approaches are time consuming. Based on information provided by a guitar tutorial uploader, it takes him about 8 hours to make a eight - minute tutorial using the second approach. This project aims to reduce the tremendous time that is required to make the tutorial, specifically for chord, yet not to compromise the user experiences.

Basic Idea and Problem Faced

- **FFT** (fast fourier transform)
  - **Bins (fft size) of 16324**: Large enough to reach the highest pitch(1046.5 Hz, pitch C6) on guitar. Small enough to tell the closest pitches(~5 Hz between pitch E2 and F2).
  - **Interference between Harmonic and real pitche**: FFT has a hard time to distinct between harmonic and real pitches played, making result from FFT less confident on detecting pitches.

Solutions

- **Observation**
  - Histogram of FFT result of first 1000 bins(Magnitude V.S. Bins)
- **Discovery**
  - For every pitch, there is at least one double harmonic with a very high magnitude in the histogram
  - An example of FFT histogram is shown by Figure 1.

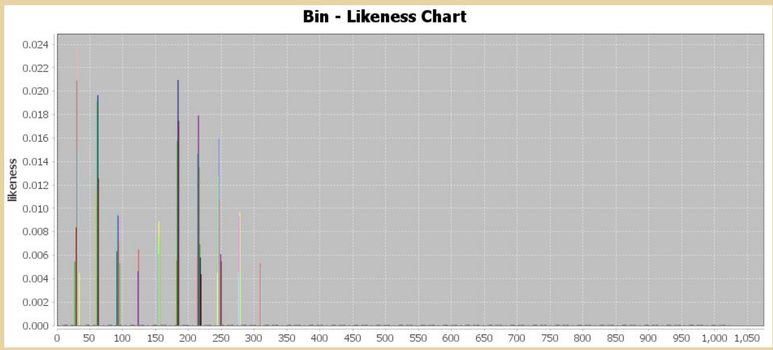

Figure 1. E2 FFT Result Histogram - Magnitude V.S. Bins

- **First Filtering**
  - Based on the property we find in the histogram, filter out those high magnitude pitches that do not have a **double harmonic** in the same frame to exclude many unexpected noises and high frequency harmonic.
- **Second Filtering**
  - Check the possibility of existence of each low multiple harmonic at each frame, and we remove those harmonic that same frequency pitches are unlikely to be played in frame.
- **Pitches Collection**
  - Based on confident pitches after two filterings, count the times that different pitches appear in the captured audio.
  - Remove some noise pitches that has only appeared once.
- **Chord Decision**
  - Compare the collection of pitches to all predefined guitar chords to decide which chord is the most likely to be the one that is being played.
  - Output result chord to UI.

Usage Example

- **Chord C**
  - As shown in Figure 2
- **Result on UI**
  - Use animation to give viewers general ideas on the order of strings and frets, being played as C chord
  - C chord tab is shown to give details about how C chord is played. (see Figure 3)

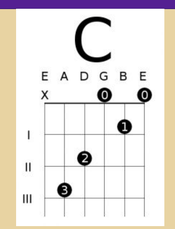

Figure 2. Guitar C chord

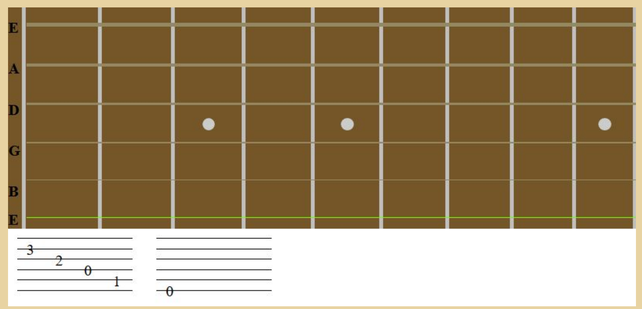

Figure 3. User Interface Example

Future Work

- **Pick up initial goal-- Detect Whole Song**
  - Cancel out aftermath of previous chord from current one to build up a complete song.
- **Distinct notes with same pitch**
  - Dig more into other properties of sound (not limited to frequency and multitude) .