THE UNIVERSITY OF BUCKINGHAM | Applied Computing Department | Sahand Shahriari
Naseer Al-Jawad | Hongbo Du

Guitar Note Transcription

PROJECT AIM

The overall aim of this project is to find a method to detect, identify and transcript soundwaves signals generated by a guitar.
In order to achieve the aim of this project an algorithm has to be implemented to:

- Cancel the noises.
- Identify beginning and end of a wave belonging to a note.
- Detecting the frequencies belonging to the soundwave.
- Identify the correct corresponding frequency.
- Convert the frequency to MIDI.

PROJECT REQUIREMENTS

- Python language is chosen for this project since it is strong in analysing waves and many libraries exist in this language that simplifies the process of implementing methods.
- Different approaches are used for each stage of this project and the most efficient ones are chosen.

INTRODUCTION

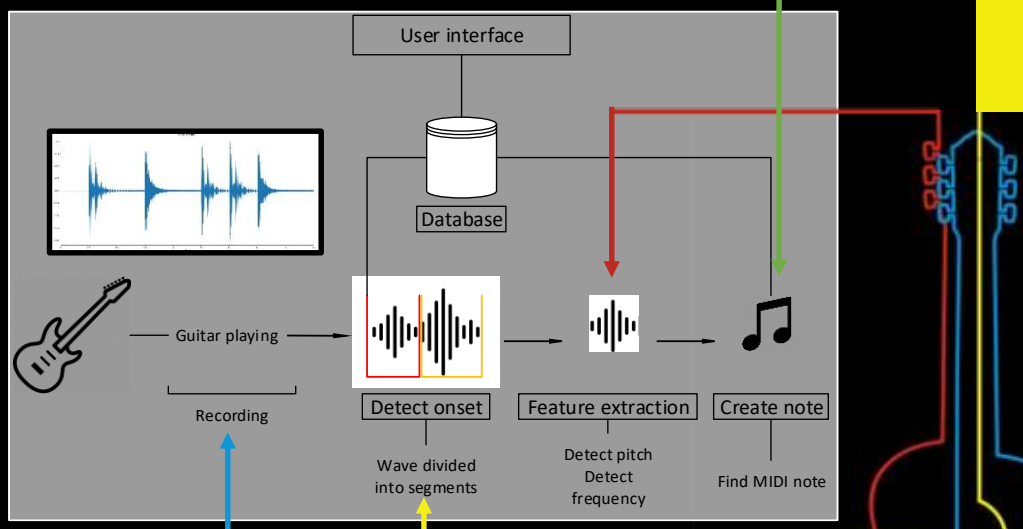
Guitar note transcription is the process that the soundwave caused by a guitar is being analyzed to generate the representing musical notes. The most important analyzations of this project are onset detection and pitch detection.
Onset detection is used to estimate when a note starts and when it ends. This is done by detecting rise in amplitude of the wave from zero. [1]
Pitch detection is done to analyze the frequencies of the wave in order to detect the right frequency so that it can be converted in to MIDI. There are several techniques for pitch detection, in this project three methods are implemented: Fast Fourier Transform (FFT), zero crossing rate and autocorrelation. [2]

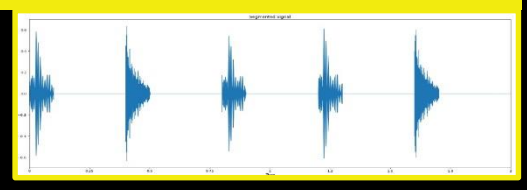
DESIGN

- Conversion to MIDI
  - Using the formula :
    $d = 69 + 12log2\,(f / 440HZ)$

```
freq2str(1090)
'C#6-29.5%'
```

- Segmentation
  - Using onset detection method to recognise when a note starts.
  - Onset detection: When the sound wave amplitude rises from zero to an initial peak.





- Detection of the right frequency
  - Using pitch detection to estimate fundamental frequencies of the wave.
  - Selecting highest frequency.

```
Calculating frequency from FFT:
54.394873 Hz
MIDI NOTE:  A1-19.15%

Calculating frequency from zero crossings:
53.825588 Hz
MIDI NOTE:  A1-37.37%

Calculating frequency from autocorrelation:
54.626626 Hz
MIDI NOTE:  A1-11.79%
```

- Noise cancelation
  - Recording 3 seconds of environment.
  - Subtracting the environment sound wave.
  - Cancelling frequencies above the range of human ear.

CONCLUSION

So far I have been able to implement:

- Onset detection.
- Pitch detection.
- Frequency selection.
- Frequency to MIDI conversion.

Future work:

- Implementation of noise cancellation.
- Interface design.

REFRENCES

[1] Bello, J., Daudet, L., Abdallah, S., Duxbury, C., Davies, M. and Sandler, M. (2005). A tutorial on onset detection in music signals. IEEE Transactions on Speech and Audio Processing, 13(5), pp.1035-1047.

[2] Gerhard, D. (2003). Pitch extraction and fundamental frequency. Regina: Dept. of Computer Science, University of Regina.