Real-Time Music Analysis and User Feedback Representation Through Unity with C#

•••

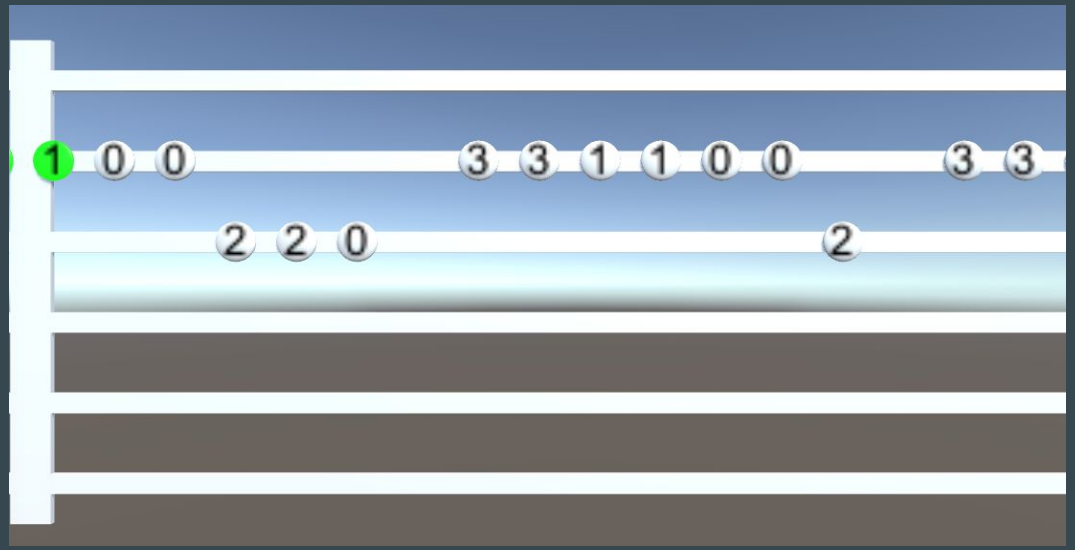
Courtney Beames and Callum Colvine

Our Idea

- Create Guitar Hero-like game in Unity with C#
- Structure is slightly different
- User plays notes shown on screen when the bar is over them
- Note changes colour when played
- Accuracy/Score at the end *To Do*

Game Aspect

Bar goes along strings, and notes will turn green or red, depending on if they are played correctly



Target Audience

- People learning to play guitar or who like guitar
  - Uses real tab music (easy to follow)
  - Gives real accuracy results

Math

Used Fourier transform function built into Unity:

- `AudioListener.GetSpectrumData(spectrum, 0, FFTWindow.Hamming)`
- Chose Hamming window to reduce leakage of signals across frequency bands
- Compared input frequency with known frequencies of notes:
- If frequencies matched, then user correctly hit the note

UI Design: 3 Options for music representation

1. Guitar Hero like style (will be referred to as “Rolling Tab”)

VS.

2. Sheet music

VS.

3. Tab music

Rolling Tab (Guitar Hero)

Pros:

- Pleasing visuals
- Users may already be familiar

Cons:

- No fret numberings on notes
- Large workload

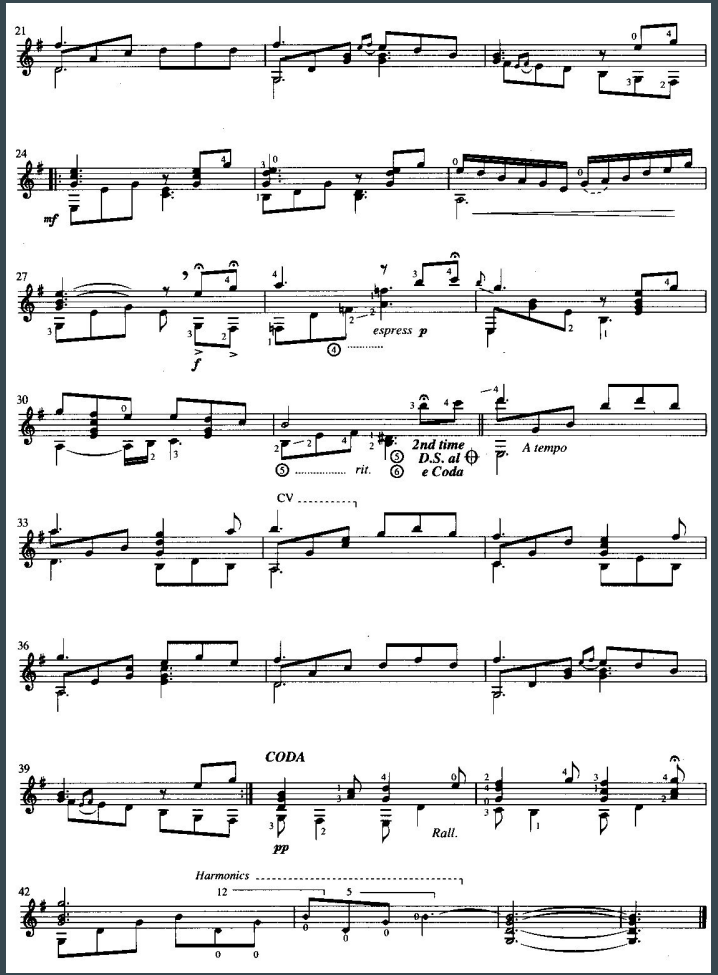
Sheet Music

Pros:

- Musician familiarity, which has been shown in studies to invoke physical response
- Easy to expand program to other instruments

Cons:

- More information dense (also a pro) which means more workload



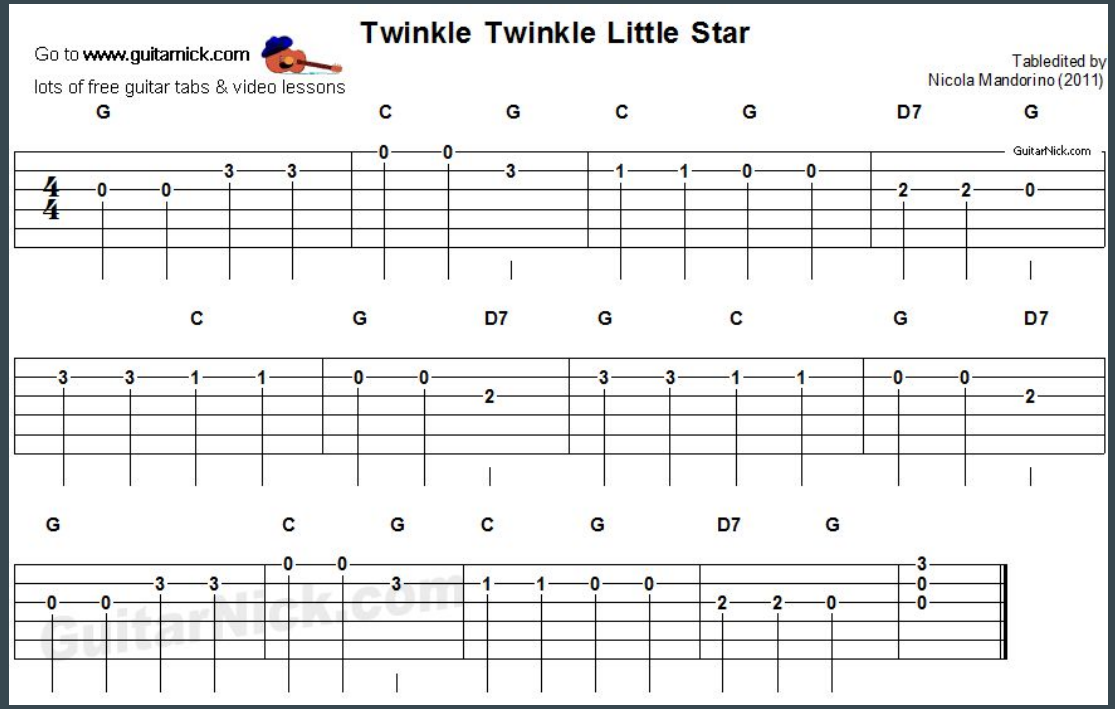
Tab Music

Pros:

- Simplicity
- Minimal information which makes implementation simpler
- Musician familiarity and easy to learn
- Tab generation software

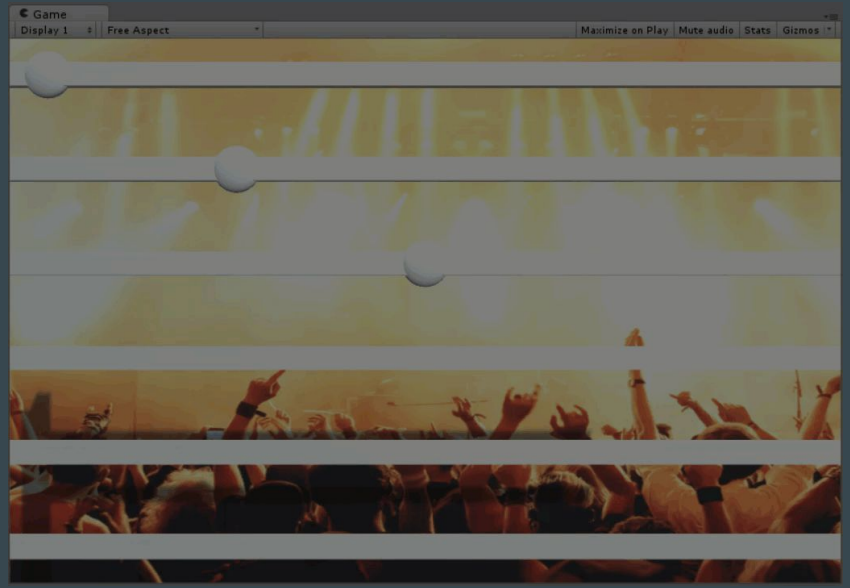
Cons:

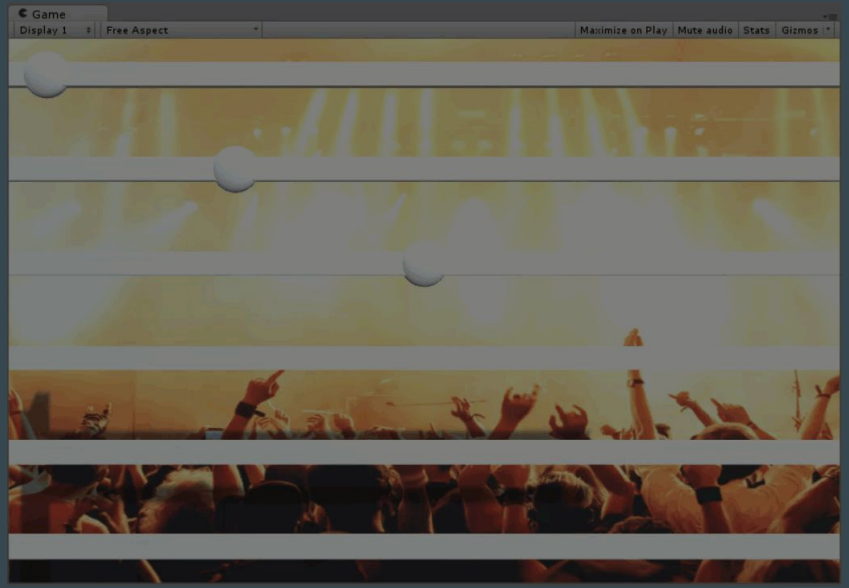
- Loses some information about the music piece



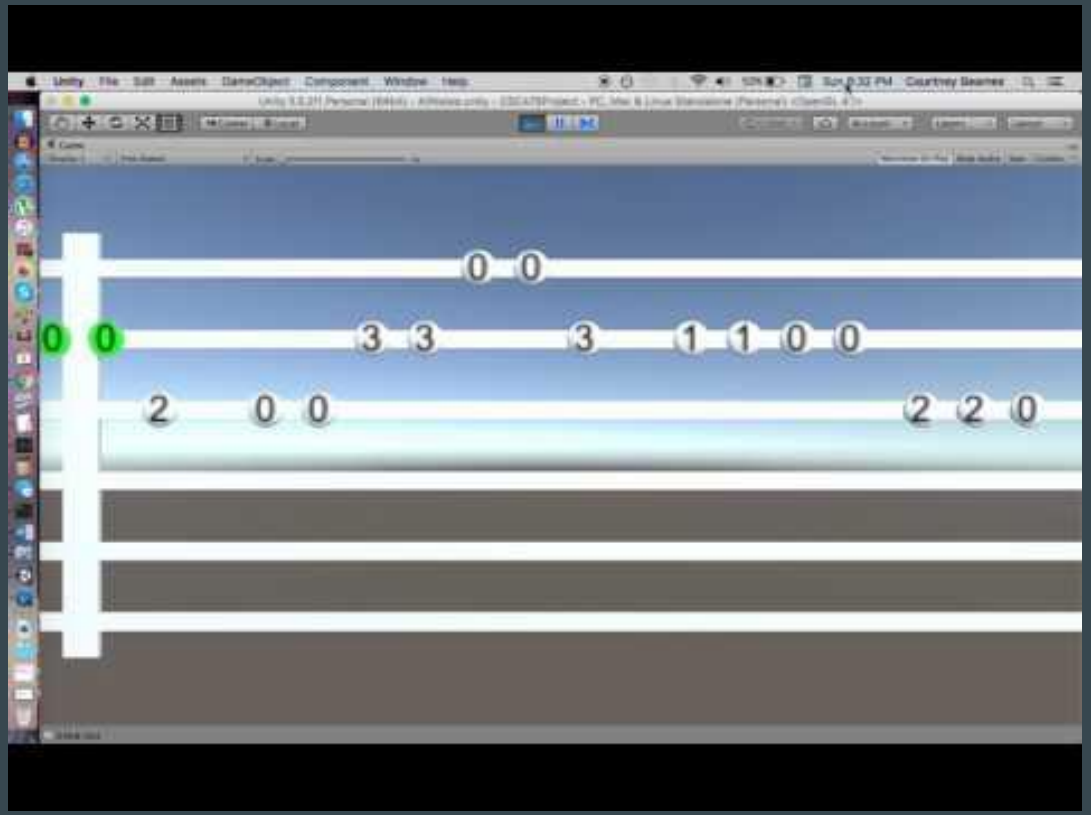
Handling of Tempo

We have a sliding bar that can speed up or slow down the rate at which we expect notes to be played





Demo Of Twinkle Twinkle Little Star played by Callum



Challenges

- Frequencies that were recognized in Unity were off the expected values.
  - Ex. E4 on Guitar was expected to be 329 Hz but when created in Audacity and analyzed in Unity it came out as 304 Hz
- This made for issues recognizing notes being played, since the frequency Unity would expect was unknown
- Individual notes were created one by one which took much time

Relevant Technologies

During our research, we encountered various other projects that would work amazingly with our program.

Hotttabs: Analyzes audio and video from popular YouTube tutorials guitar songs and automatically generates tab music.

Guitar Tab Data Mining: Listens to songs from various sources and makes a databases of their corresponding tabs.

Future Additions

- Real-time input analysis
- Progression based song unlocks
- Provide more visually appealing aspects to the UI
  - Ex. Images of guitars, different audience backgrounds/venues
  - These could also be unlocked through progression
- User created songs
- Multiple users at one time
- Different instruments

Thanks for listening!

Any Questions?