PerformScore: TOWARD PERFORMANCE VISUALIZATION WITH THE SCORE ON THE WEB BROWSER

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ABSTRACT

We present a score-based web interface for classical music listening. The interface is designed for comparative listening of a musical piece. Employing the results of audio-to-score alignment and note intensity estimation from recordings, the interface provides the musical score of the piece with score-synchronized recordings. The score of the music is rendered on the web browser by Verovio. The note intensity, which is estimated from the recordings, is mapped into the opacity of each note in the score.

1. INTRODUCTION

Music exists in various forms of information: score, lyric, audio recording, video recording and so on. This multi-modality is especially important in classical music where a single piece of music is usually rendered into various forms of recordings by different performers. Therefore, there has been much research on developing interface for combining this multi-modal information [2]. Some of them leveraged web environment that has consistently improved the multimedia capability [3, 6].

Our goal is designing a web interface that makes the comparative listening more convenient so that listeners can easily recognize the difference among performances given a piece of music. Based on pre-computed audio-to-score alignment, our interface automatically follows the current playback position on the score. The music notation is rendered in the web browsers using the Verovio toolkit [1]. Users can easily switch among different performances on the same piece while keeping the current playback position. Also, the estimated intensity of individual notes is visualized on the score by the opacity of each note symbol.

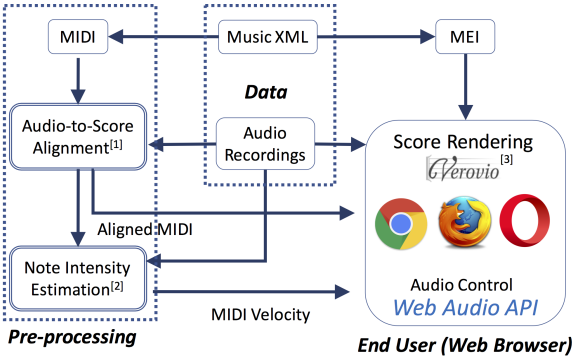

Figure 1. The diagram of the system structure

2. SYSTEM STRUCTURE

2.1 Data Pre-processing

We collected the digital scores from MuseScore [2] where users can upload the scores that is converted into musicXML format. We converted the files to both MIDI and MEI files. We used the MIDI files for audio-to-score alignment and the MEI files for rendering score images on the web browser.

For the audio-to-score alignment and note intensity estimation, we utilized our homegrown algorithms. The audio-to-score alignment is based on RNN-based multi-pitch detection and onset detection [5]. The note intensity estimation applied after the alignment is based on score-informed Non-negative Matrix Factorization (NMF) [4]. Finally, we obtained the time stamp and velocity of each note in the MIDI file.

2.2 Web Interface

The Verovio toolkit supports fast and high-quality rendering of the music score in SVG. Unlike employing the fixed image of score, Verovio enables the score to interact in a various way. For example, the browser can render the score with a size that fits into the user's own display size. Also, the system can easily track the note-level playback instead of measure-level.

Users can select a composer, a piece of music and multiple recordings from the menu. The selected recordings are loaded and decoded by the web browser. After the audio

[1] http://www.verovio.org
[2] https://musescore.com

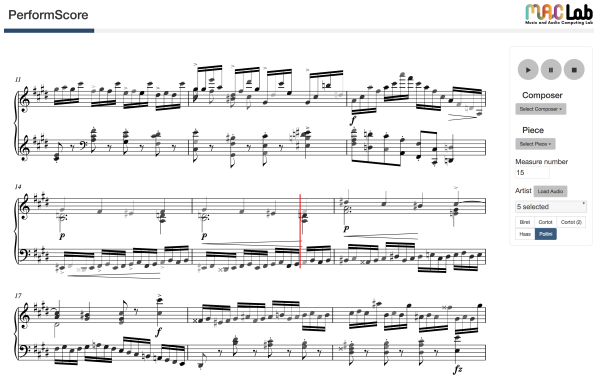

Figure 2. The screenshot of the web interface

decoding is finished, users can freely navigate the music by clicking on the score or the progress bar in the top area.

Users can immediately switch among selected recordings. Since all recordings are pre-aligned with the score, the newly selected recording starts from the previously played notes without abrupt jump of the current note position. Also, we added an crossfade effect between the two audio tracks to avoid possible audio glitches using the web audio API.

Our ultimate goal of this project is visualizing the characteristics of music performance on the score including tempo change and dynamics. As a first step, we visualized individual note intensity by the opacity of each note on the score. That is, louder notes become darker with higher opacity and softer notes become thinner with low opacity. Thus, if users select different recordings, the transparency of notes will changes according to the dynamics in each performance. For the future work, we will visualize tempo change of the performance on the score. Also we plan to add visually dynamic and lively features, for example, those similar to performance worm [1]). The PerformScore demo is available at the website below [3] .

3. REFERENCES

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