PIANO PRECISION: VISUALIZING PRACTICE SUBTLETIES OF PIANO LEARNERS

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ABSTRACT

Unlike most piano tutoring applications, which guide students to play correct notes, Piano Precision focuses on guiding students to play better sounding notes. This application visualizes essential aspects (such as the tempo) of a performance, to help piano learners reflect objectively on their playing. The user may record and analyze multiple takes before moving on to a different score. A video demo is included to show the functionality of this prototype. Furthermore, this tool can be useful to study music learning and teaching, and support musicology research.

1. PURPOSE

Most piano tutoring applications guide students to play *correct* notes, instead of better sounding notes. For example, Yousician and Simply Piano color the correctly played notes as the user progresses through a song. Some of these applications, e.g., Piano Marvel, need to be connected to a digital piano or an electronic keyboard with a cable, and thus aren't suitable for someone who wants to learn to play acoustic pianos. In contrast, the application described here, Piano Precision, targets students who are able to tell on their own when they've hit wrong notes, but who lack the ability to make more sophisticated judgments about the quality of their playing, especially on an acoustic piano. This tool focuses on visualizing essential aspects of a performance (e.g., tempo control, loudness, or articulation) that are not easy to notice for beginner and intermediate students, thereby making these subtle aspects explicit for those students.

Making music is about much more than playing the correct notes. The purpose of Piano Precision is to help learners reflect on the quality of their playing, and help them evaluate it critically by examining their practice recordings in greater detail. Through this process, students should improve their self-reflection skills gradually. In addition, by automatically collecting and analyzing student practice recordings, this tool can potentially enhance studies of music skill acquisition. Current studies of instrument learning rely on survey data, such as interviews and self-reports (e.g., [1, 2]), which involve irreducible levels of noise and subjectivity. Data-driven analysis of large scale student practice data could be transformative for gaining insights into how students learn an instrument.

2. APPLICATION DESIGN

As depicted in Figure 1, there are three steps involved in using this application. The user first chooses the score to practice, which will appear in the left pane of the main window (Figure 2). The user then clicks the "record" button and starts to play. After each recording, the performance is automatically analyzed and visualized in the two panes on the right. The upper pane shows the spectrogram and the onsets of each chord, and the lower pane shows one essential aspect of the performance—in this prototype, the tempo fluctuation of the performance. Section 3 (below) includes more details about these two panes. At this point, the user may like to reflect on the past performance by playing back the recording (perhaps multiple times) and observing the visual feedback in the lower pane. The user may keep practicing this score by repeating Step 2 and Step 3, working to improve the quality of the playing by gaining insights from previous takes. After any take, the user may switch to a different score by going back to Step 1.

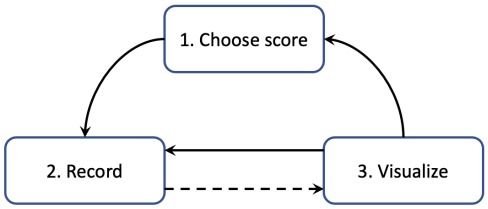

Figure 1. Three steps to use the application. The dashed arrow represents an automatic process.

Figure 2 shows the graphical interface of the main window, with the above three steps labeled in the corresponding areas. The current prototype is built on Sonic Visualiser [3], with modifications to the layout of the main window, and an additional plugin for auto analysis.

3. PERFORMANCE VISUALIZATION

One of the most important aspects of playing music is timing: controlling the local tempo (or the duration of each musical event) intentionally and precisely, in order to

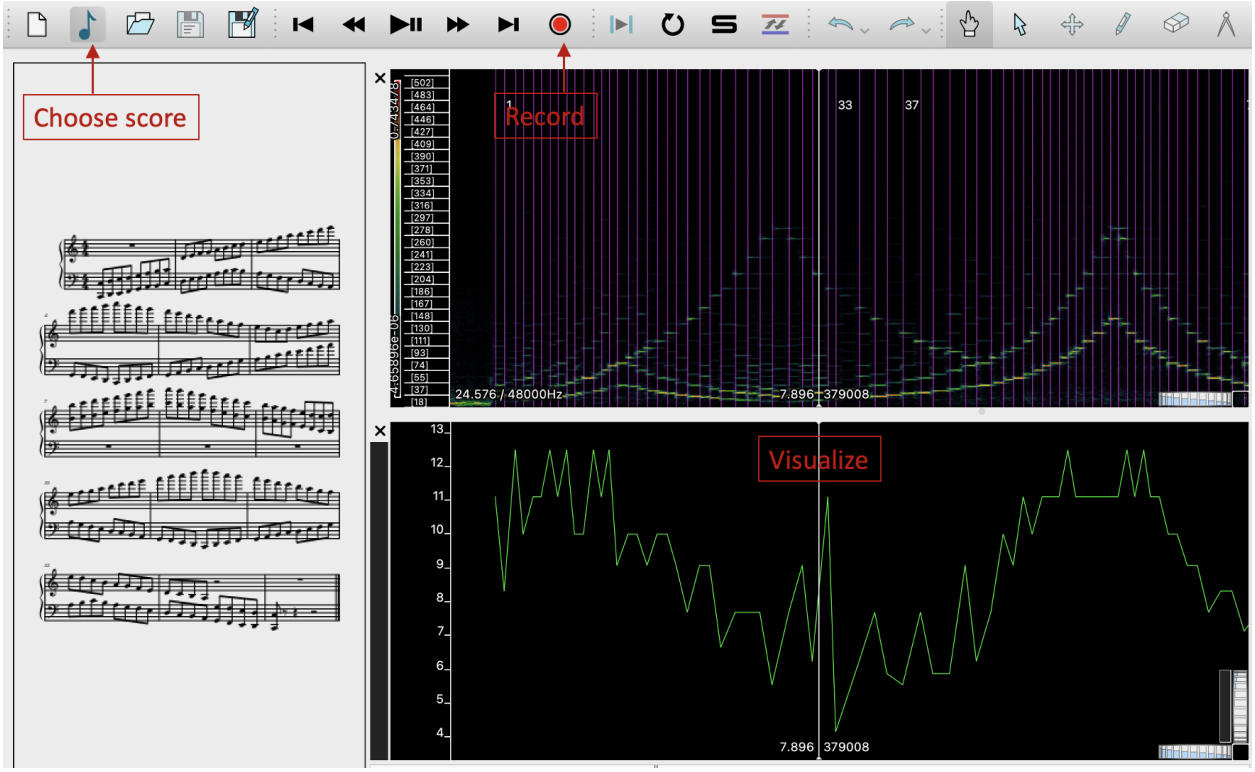

Figure 2. The main window of Piano Precision.

achieve one's intended expressive interpretation of a piece. One challenging, but essential, exercise is to play a scale (or a passage) evenly, with steady tempo—a skill that can be difficult to self-evaluate for beginners. It's not unusual for beginners to think their timing to be "perfectly even," and such mistakes are likely to be repeated and reinforced, unfortunately, during a practice session. To help learners reflect on their timing objectively, the lower pane (as shown in Figure 2) visualizes the tempo fluctuation of a recorded performance.

The upper pane in Figure 2 shows the spectrogram and the onsets of each chord. The onsets are calculated through an (offline) audio-to-score alignment algorithm, based on [4]. The local tempo can then be calculated from these onsets. A video demo containing analyses on recordings of different tempo fluctuations can be found at facultystaff.richmond.edu/∼yjiang3/papers/ismir21/.

4. FUTURE WORK AND EXTENSIONS

There are several aspects of future work in various stages of development. First, it would be beneficial to visualize other components of the performance, e.g., loudness and tone, as well as the tempo, and perhaps also allow the user to choose which component to see at a time. Second, it would be easier to analyze a recording if the score (in the left pane) is interactive, highlighting the notes near the cursor location in the right two panes. Third, support for selecting a range of the score would be worthwhile, as a user might prefer to focus on practicing only one section of the score.

There are also related areas of inquiry where this application may be beneficial. As mentioned in Section 1, this application can be used to collect and analyze student practice data. The results of this process may be used to support a data-driven approach to studying piano learning, and contribute to new piano pedagogy. In addition, this application may also contribute to musicology research by making it possible to automatically analyze large-scale piano performance data sets.

5. REFERENCES

[1] G. E. McPherson and J. M. Renwick, "Self-regulation and mastery of musical skills," *Handbook of self-regulation of learning and performance*, pp. 234–248, 2011.

[2] G. E. McPherson, M. S. Osborne, P. Evans, and P. Miksza, "Applying self-regulated learning microanalysis to study musicians' practice," *Psychology of Music*, vol. 47, no. 1, pp. 18–32, 2019.

[3] C. Cannam, C. Landone, and M. Sandler, "Sonic visualiser: An open source application for viewing, analysing, and annotating music audio files," in *Proceedings of the ACM Multimedia 2010 International Conference*, Firenze, Italy, October 2010, pp. 1467–1468.

[4] C. Raphael, "Automatic segmentation of acoustic musical signals using hidden markov models," *IEEE transactions on pattern analysis and machine intelligence*, vol. 21, no. 4, pp. 360–370, 1999.