SkyNote: An AI-Enhanced Learning System for Violin

ABSTRACT

Playing a musical instrument is a highly complex activity. It requires a complex combination of mental and sensorimotor skills, which are acquired during a long learning trajectory. Music pedagogy represents a long-standing tradition, which is mostly based on a master-apprentice model in which the student observes and imitates the teacher, the teacher provides verbal feedback on the performance of the student, and the student engages in long periods of self-study without teacher supervision. However, learning under the master-apprentice model is difficult because the time lag between the student‘s performance and the teacher‘s feedback makes the feedback to be dissociated from the online proprioceptive and auditory sensations accompanying the performance (Welch 1985) – this is especially relevant since most of the student‘s performance practice takes place long after the teacher‘s feedback. The resulting long periods of private study by the student frequently make the learning of musical instruments a rather harsh and solitary experience, resulting in high abandonment rates (Asmus, 1986; Aróstegui, 2011). In this abstract, we present the results of TELMI (www.telmi.upf.edu), an H2020 RIA European project, which aimed to address these problems by contributing to the design and implementation of new multi-modal interaction systems for music learning complementary to traditional teaching. In particular, we will describe SkyNote, a technology-enhanced music learning application based on state-of-the-art artificial intelligence, audio processing, and computer vision technologies. SkyNote provides students with tools to detect and correct their sound quality, intonation, rhythm, and gestures/posture. SkyNote assesses the quality of timbre in violin performances using machine learning techniques (Giraldo et al., 2019). After collecting audio recordings of several tone qualities and performing perceptual tests to find correlations among different timbre dimensions, we processed the audio recordings to extract acoustic features for training tone-quality models. Computational models were trained using machine learning techniques with selected audio features to provide feedback on tone quality. A real-time feedback system designed for pedagogical use was implemented in which users can train their own timbre models to assess and receive feedback on their performances. Similarly. SkyNote assesses the quality of movement/gestures in violin performances using machine learning techniques (Dalmazzo et al., 2022). After collecting videos of several correct and incorrect gestures which were labeled by an expert, we used the 2D video data as input to a deep neural network to extract 13 body points of interest (e.g. wrists, elbows, shoulders, head, hips). We then used these points of interest to train a classifier for correct and incorrect instrumental techniques. Students receive real-time feedback on their posture. Based on preliminary studies with music students, it seems that SkyNote, as a

complementary tool to traditional music teaching, can contribute to more efficient music practice and instrument training.

KEYWORDS

Technology-Enhanced Music Learning, Machine Learning, Signal Processing, Motion Capture, Violin Learning

TOPICS

Intelligent Tutoring Systems; Machine Learning; eLearning Hardware and Software; Tools to Assess Learning; Educational Data Mining; Virtual and Augmented Learning Environments ;

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