The Complete Classical Music Companion V0.9

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ABSTRACT

We present a first integrated prototype towards our long-term goal of building a complete classical music companion. When listening to a live performance of classical piano music, our system is able to almost instantly identify the piece that is being played, and the position within the piece. It then tracks the performance via an accurate and robust score following algorithm and shows the sheet music accordingly. Furthermore, the system continuously re-evaluates its current position hypotheses within a database of scores (roughly 1,000,000 notes!) and is capable of detecting arbitrary 'jumps' by the performer (e.g., leaving out repetitions, re-starts at any position, etc.) – not only within a piece, but within the complete database of classical piano scores.

1. THE COMPLETE CLASSICAL MUSIC COMPANION

The 'Complete Classical Music Companion' is a long-term endeavour of ours, with the goal of building a versatile system that is able to follow and understand live performances of classical music (at least to some extent), and to be of use both for musicians and for consumers of classical music. In this paper we present a first prototype that has two important capabilities that we believe such a system must possess: (1) automatic identification of the piece it is listening to, and (2) following the progress of the performer(s) within the score over time.

To support these two capabilities, the companion is provided with a database of sheet music in symbolic form. Currently the database includes, amongst others, the complete solo piano works by Chopin and the complete Beethoven piano sonatas, and consists of roughly 1,000,000 notes in total. When listening to classical music (so far piano music only, due to restrictions of the transcription component, see Section 2), our system is able to identify, within a few seconds, the piece that is being played, and the position within this piece. It then tracks the progress of the performers over time, i.e., at any time the current position in the score is computed. Furthermore, it continuously re-evaluates its hypothesis and tries to match the current input stream to the complete database. Thus, it is able to follow any action of the musician(s), e.g., jumps to a different position or an entirely a different piece – as long as the piece being played is part of the database. Generally, detecting these jumps takes between 5 and 10 seconds. The system is tolerant to performance errors and slight variations, and independent of the tempo in which the piece is being played.

The basic system described above enables a range of possible applications. One of the main goals of our companion is to enhance the listening experience for the consumer of classical music. Our vision is to ultimately see our system implemented on a mobile device (i.e., a smart phone or a tablet computer), which then can be used when listening to music at home or at a concert hall. The user can be automatically presented with the respective sheet music, with a marker showing the exact position. Additionally, the system can present meta-data, like information about the structure of the piece and historical information about piece and composer, and give hints about what to listen for at specific moments.

Also, performers might use our system during practice, as the system can follow them and show the sheet music accordingly, even if they repeat a section over and over or only play parts of the score they need to rehearse. They can simply sit down at the piano, query the sheet music by playing the first few beats, and start practicing.

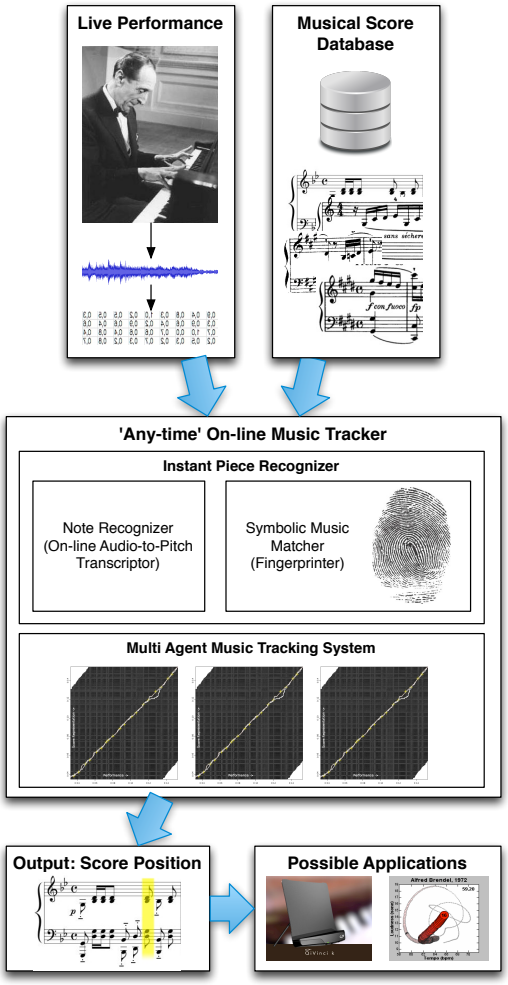

Fig. 1: System Overview

2. SYSTEM OVERVIEW

Figure 1 gives an overview of our music companion. The system consists of two main components that are running in parallel: (1) an 'Instant Piece and Position Recogniser' and (2) a 'Multi Agent Music Tracking System'.

The recogniser is based on an on-line piano music transcription algorithm [3], which takes the audio stream and translates it into symbolic information (a list of pitches with time stamps). The list of notes of the last seconds of the live performance is then matched to the database of sheet music via a tempo-independent fingerprinting method [2]. This process is continuously running in the background, regularly providing new piece and (rough) position hypotheses for the tracking component.

The more precise tracking component takes these rough hypotheses and initialises individual trackers at these positions, which try to match the current audio input to these respective positions in the sheet music (for more information about the tracking algorithm see [1]). The trackers try to follow the progress of the musician(s) over time. At each point in time, a single tracker, which produces the least costs during the alignment process, is marked as active, i.e., represents our system's belief about the current position in the database. At regular intervals, trackers which have large alignment costs are stopped and reinitialised with new position hypotheses computed by the recogniser.

3. CONCLUSION AND FUTURE WORK

We have presented a first prototype of a system that identifies and tracks music in real time, using a very large score database. Besides trying to remove the restriction to piano music, we are now in the progress of integrating additional features, such as an algorithm that automatically classifies the sound it is listening to (e.g., music, speech, applause or silence). That will make it possible to react more naturally to the typical sound environment of a concert hall.

4. ACKNOWLEDGEMENTS

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5. REFERENCES

[1] A. Arzt, G. Widmer and S. Dixon. Adaptive Distance Normalization for Real-time Music Tracking. In *Proceedings of the European Signal Processing Conference*. 2012.

[2] A. Arzt, S. Böck and G. Widmer. Fast Identification of Piece and Score Position via Symbolic Fingerprinting. In *Proceedings of the International Conference on Music Information Retrieval*, 2012.

[3] S. Böck and M. Schedl. Polyphonic Piano Note Transcription with Recurrent Neural Networks. In *Proceedings of the International Conference on Acoustics, Speech, and Signal Processing*, 2012.