A TOOL FOR THE ANALYSIS AND DISCOVERY OF OTTOMAN-TURKISH MAKAM MUSIC

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ABSTRACT

We present a web application for the analysis and discovery of Ottoman-Turkish makam music. The tool uses an audio-score alignment methodology developed for this music culture for the analysis. It stores the data to be analysed and also executes the analysis algorithms. In the visual interface, the extracted features and alignment results are shown in an audio player, rendering music score and audio representation synchronous to the playback. We plan to improve this prototype in the future mainly for musicological research and music education.

1. INTRODUCTION

Ottoman-Turkish makam music (OTMM) is a profound music tradition, with many unique characteristics within its melodic (*makam*) and rhythmic framework (*usul*). These characteristics bring several challenges in automatic analysis of this music [1]. The tradition is predominantly oral; nevertheless descriptive music scores are used as a complementary reference in music performance and education.

We have been developing an audio-score alignment methodology for OTMM (Section 3) to facilitate many computational tasks by exploiting both the audio and symbolic representations of the music. We have created a web application [1] to showcase our technology. The application stores the data, executes the algorithms in our alignment methodology (Section 4) and display the analysis results synchronous to the audio playback (Section 5).

2. MUSIC CORPUS

Within the Compmusic project, we have gathered 2205 music scores [3] and more than 6000 audio recordings of OTMM [9]. The metadata is stored in MusicBrainz. [2]

To render each score element synchronously in the interface (Section 5), we first convert the score in text format to MusicXML and then to SVG. We use LilyPond for MusicXML to SVG conversion, which allows us to record a mapping of each element between these different formats. This way, each object in the SVG file can be referenced by the note that it represents in the score.

3. METHODOLOGY

First, we divide the score into sections using the implicit and explicit section markings in the scores [3]. For each section, we compute a synthetic melody according to the tempo given in the score [8]. From the audio recording, we extract a predominant melody using the method explained in [1].

To obtain the tonic frequency, we use a score-informed tonic identification method [6]. The most confident partial-alignment resulting from the tonic identification is also used to estimate the tempo of the performance [2]. The tonic and the tempo is used to normalise the predominant melody and re-synthesise the melody of each score section, respectively.

Next, we find the time-intervals where each section is performed in the audio recording using the section linking methodology explained in [8] and then obtain the note-level alignment [7]. Finally, the octave errors in the predominant melody are corrected according to the pitch heights of the aligned notes.

4. DATA STORAGE AND ALGORITHMS

Dunya [4, 5] is a web application that is developed with Django framework. The audio recordings, music scores and relevant metadata are stored in a PostgreSQL database. It's possible to manage information about the stored data and submit analysis tasks on the data from the administration panel. The output of each analysis can be used as an input of another analysis module and/or be displayed on the interface (Section 5).

This work is partly supported by the European Research Council under the European Union's Seventh Framework Program, as part of the CompMusic project (ERC grant agreement 267583).

[1] The demo is accessible at: http://dunya.compmusic.upf.edu/makam

[2] Please visit http://compmusic.upf.edu/node/280 to access the data, metadata, code of the web application and the audio-score alignment methodology, extracted features and analysis results.

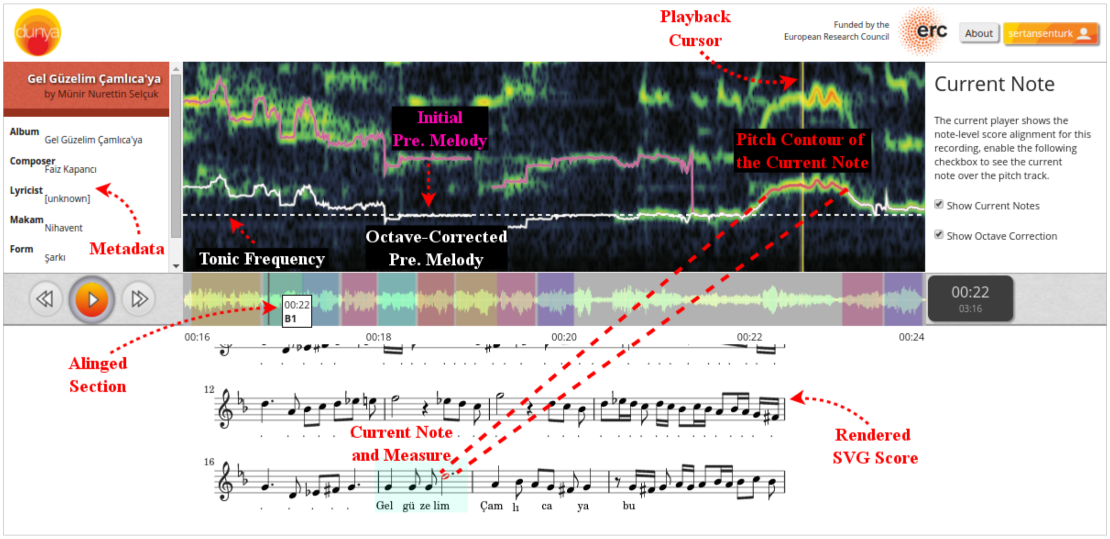

Figure 1. The recording page

5. INTERFACE

The interface interaction is developed with Javascript. In the front page, the user can search by composition name and the search can be filtered by *makam, form* and *usul*. The results of the query are displayed simultaneously using Ajax. Once the user selects a recording, the recording page is opened (Figure 1). The page consists of four different parts:

1. **Left Panel:** The metadata about the composition and the recording.
2. **Top Panel:** The audio features. These include a spectrogram, initial and (if enabled) octave-corrected predominant melody. The tonic frequency is drawn with a dashed line. The chunk of the predominant melody on the time-interval of the current aligned note is highlighted in red.
3. **Centre Panel:** The playback buttons, audio timeline, playback time instance and audio duration. The audio waveform is drawn in the background of the timeline. The timeline can be clicked to jump the playback to the desired time instance. The coloured regions mark the time-intervals of the performed sections. When the user hovers over the panel, the name of the section at this time is displayed.
4. **Bottom Panel:** The music score. The SVG elements corresponding to the current note (if enabled) and the measure are highlighted. We obtain the SVG element related to the aligned note from the mappings mentioned in Section 2. We also find the current measure by searching the two closest measure line elements, which encloses the position of the note element in the SVG file.

6. CONCLUSIONS

We have presented a tool, which can be used for the analysis and discovery of collections of audio recordings and music scores of Ottoman-Turkish makam music. So far, we have analysed over 1500 audio-score pairs. We plan to incorporate note modelling and score-informed rhythmic analysis in the future. We aim to further develop these technologies to support tasks in music discovery, musicological research and music education.

7. REFERENCES

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