A PLATFORM FOR PROCESSING SHEET MUSIC AND DEVELOPING MULTIMEDIA APPLICATION

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ABSTRACT

Imaging when reading sheet music on computing devices, users could listen audio synchronizing with the sheet. To this end, the sheet music must be acquired, analyzed and transformed into digitized information of melody, rhythm, duration, chord, expressiveness and physical location of scores. As we know, the optical music recognition (OMR) is an appropriate technology to approach the purpose. However, the commercial OMR system of numbered music notation is not available as best as our knowledge. In the paper, we demonstrate our proprietary OMR system and show three human-interactive applications: sheet music browser and multimodal accompanying and games for sight-reading of sheet music. With the illustration, we hope to foster the usage and obtain the valuable opinions of the OMR system and the applications.

1. INTRODUCTION

There are commercial products of optical music recognition (OMR) for sheet music in staff notation, for example Sharpeye, Photoscore in Sibelius, Smartscore, and Midiscan in Finale. But, for the sheet music, as shown in Figure 1, of numbered music notation [1] called 'jiănpŭ' in pinyin for Mandarin, the functions of commercial product, it seems that the visibility of the OMR system is low. In our previous research [2], we design an eco-system of OMR for numbered music notation. The eco-system majorly includes the methods and utilities to generating groundtruth, recognition, and rendering of sheet music, and evaluation metrics of OMR system.

Such a notation has been used extensively in Asia for music practitioners to distribute their musical works because of well acceptance by the consumers. The notations include digits, alphabet, and characters as the same shape as ASCII symbols, and other glyphs such as ties, slurs, tuples, etc., as those of staff notation. An exemplar music sheet, traditional Chinese song, is shown in Figure 1.

Setting up the goal to improve the experience and ability of sheet music sight-reading, we develop the multimodal and multimedia applications. There are three major functions: sheet music browser, singing accompaniment and games for pitch and note length error detection.

2. OMR ECO-SYSTEM

Because the lack of public dataset, we build up the ecosystem for OMR system from the scratch. Figure 2 (a) shows the flow to construct the building blocks of the ecosystem. The system comprises of the four major processing blocks: 1) preprocessing of document image; 2) musical glyph definition and recognition; 3) music notation assembly by graphical and musical sematic; 4) symbolic representation and musical output. Besides, groundtruth construction and performance evaluation are also included.

3. MULTIMODAL AND MULTIMEDIA APPLICATION

In sheet music browser, the sheet music is located by different indexing methods and displays in a window with title on the top. Three kinds of indexing methods are provided: 1) by the "keywords" of song title; 2) by number of "strokes" of the first character of song title; 3) by "table of contents". This is the usage convention for a paper songbook. For multimodal accompaniment for sight-reading, the interface is similar to that of music player. The audio play back is synchronized with sheet music reading, in which the current location is highlighted with the cyan '^' sign. Besides, the playing position could be changed by double clicking on sheet music. In the game mode, the melody is playing as the multimodal accompaniment do but with randomly generated note pitch and length errors waiting to be detected by the players.

The screen shot of the sheet music browser in Figure 1 (a) is shown with indexing method labels at left hand side. After indexing, the list menu will show all the candidate songs with the index method indicated at the left. When some item is clicked, the sheet music will appear for preview with scroll bar in the panel with title "Sheet Music Preview".

In the singing accompaniment as the screen shot of the Figure 1 (b), the application synthesizes the note audio of sheet music with the specific tempo value indicated in the

Figure 1. (a) Sheet music browser (b) multimodal accompanying (c) game for pitch and length error detection

slider. When playing, the "^" sign will indicate the current note as the melody is going. User could double click on the screen to change the playing position or change the playing tempo by the slider. Beside of playing, the play button also has the function to replay the song from the beginning of the sheet music.

In the game as the Figure 1 (c), some of notes are generated erroneously and randomly. The game player clicks on the screen of sheet music to indicate the location of the erroneous notes. The background scoring agent will evaluate the clicking results and indicate the results on the sheet with "v" and "x" sign for correct and wrong ones, respectively. The agent also makes scoring on the top and central area. The scoring includes score(F-measure), hit and miss. The hit item has two numbers separated by slash "/". The number at left is hit number, and the number at right is the count of the generated errors.

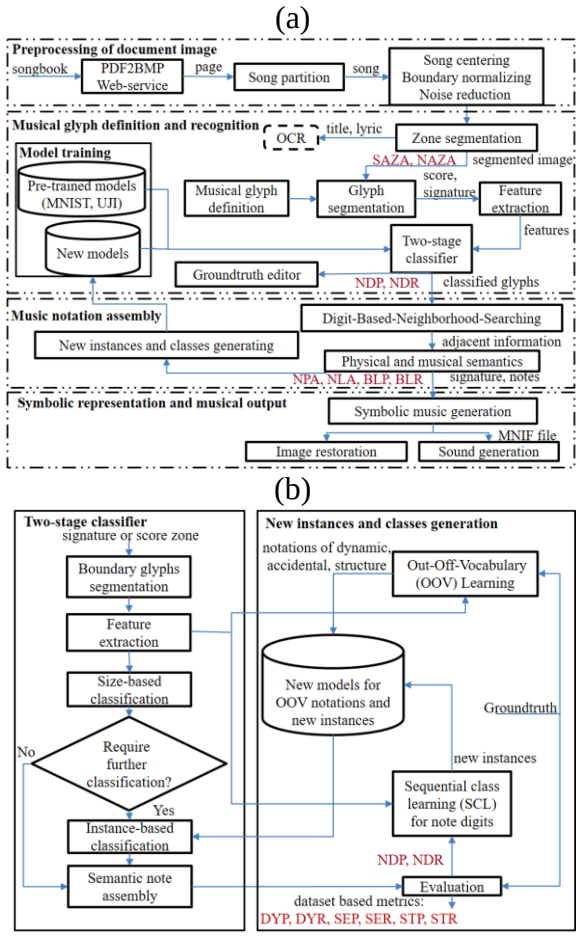

Figure 2. *(a)* OMR system flowchart with evaluation metrics in brown, (b) two-stage classification and learning for classes and *instances*

4. CONCLUSIONS AND FUTUREWORK

In the demo, we introduce our OMR ecosystem and demonstrate the application of multimodal and multimedia songbook. In order to have the automatic OMR tool, we empirically define the process flow and implement the prototype. Moreover, we took on the results of OMR to implement the multimodal interactive and multimedia application of songbook. To summarize, the research provides a promising approach to produce, distribute, and use sheet music joyfully.

In the future work, we could add the MIR functions, such as singing assessment, synchronization of audio source, score following based on some fundamental research achievement.

Acknowledgments

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5. REFERENCES

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