

Optical Character Recognition for Musical Notes and Playback

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Abstract—OCR for music recognition and playback aims to address the problem of music data acquisition. It accomplishes this by using OCR to recognize the music score and converts it into MusicXML file format. MusicXML file is the industry standard way of representing western musical notation. The conversion of the recognized symbols to MusicXML file format enables the user to store, edit, play and share his music. The main motivation behind the project is to develop software like “Cam Scanner” for musical score sheets that can be used by learners, professional musicians and publishers with ease. The character recognition has been implemented through template matching using normalized cross correlation. The Music table of recognized symbols with (x,y)coordinates, staff number, duration, stem, octave, step and alter is generated, which will be helpful to test the correctness of the recognized symbols. Currently 10 different instruments such as guitar, violin, mandolin, melodica, banjo, koto, kazoo, electric guitar, sitar, mezzo-soprano are supported for music playback by using Muse Score software. The implementation was done through in Matlab(version R2014a - 8.3.0.532).

Keywords—OCR, MusicXML, Cam Scanner, Template matching, Normalized cross correlation, Matlab.

I. INTRODUCTION

A. Subsection Heading Here

II. SOFTWARE REQUIREMENTS

The input image acquired has to be subjected to various processing operations for recognising the characters in the music score sheet. Thus, the platform used for the implementation should support image processing operations. Matlab has extensive support for image processing operations through Image Processing Toolbox”. Matlab also has Data and File Management Toolbox which can be used to read, write and generate XML files. MusicXML being one of the types of XML file, the toolbox will be able to handle it’s basic operations also. Hence Matlab becomes a good choice for implementation. For reading MusicXML files MuseScore can be used. MuseScore is a free and opensource score writer software with rich features.

A. MATLAB

MATLAB (MATrix LABoratory) is a multi-paradigm numerical computing environment and fourth-generation programming language developed by MathWorks. It lets explore and visualize ideas and collaborate across disciplines including signal and image processing, communications, control systems,

computational finance and many other technical areas. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, Java and Fortran.

Image Processing Toolbox provides a comprehensive set of reference-standard algorithms, functions and applications for image processing, analysis, visualization and algorithm development. It can be used to perform image analysis, image segmentation, image enhancement, noise reduction, geometric transformations and image registration.

Image Processing Toolbox supports images generated by a wide range of devices, including webcam, digital cameras, satellite and airborne sensors, medical imaging devices, microscopes, telescopes and other scientific instruments. It supports all standard image formats. The toolbox includes specialized filtering routines with morphological operators that can be used to enhance contrast, remove noise, thin regions or perform skeletonization on regions. Morphological functions in Image Processing Toolbox include: dilation, erosion, opening and closing. Image segmentation algorithms determine region boundaries in an image. It also has a generalized multidimensional filtering function that handles integer image types, offers multiple boundary-padding options and performs convolution and correlation.

MATLAB also supports XML format through XML toolbox. The XML Toolbox converts MATLAB data structures of any level of nesting into an XML string. It has various functions to create tags, elements, child elements etc. Using this, recognised music symbols are encoded in MusicXML format.

B. MuseScore

MuseScore is a score writer for Windows, OS X, and Linux. Created by Werner Schweer, it is released as open source software under the GNU General Public License. It supports a wide variety of file formats and input methods. MuseScore’s main purpose is the creation, editing and printing of various types of musical scores in a What-You-See-Is-What-You-Get environment. It supports most types of notations, including jazz lead sheets and prints or exports high quality engraved sheets. MuseScore’s notation engine conforms to industry notation standards.

MuseScore natively supports linked parts and part extraction, MIDI input, unlimited staves, percussion notation, cross-staff beaming, lyrics and multiple verses. The functionality of

MuseScore can be further extended by making use of its plugin system. Scores may be exported from MuseScore to many different file types, including WAV files - this preserves as much subtlety as the program is able to communicate. The result is a standard stereo WAV file which can be burned to a CD for presentation purposes without further processing.

MuseScore can import MusicXML, MIDI, Band-in-a-Box, Guitar Pro, capella and Overture formats, as well as its own MuseScore Format and Compressed MuseScore Format. It can export to MusicXML and MIDI file formats. Audio can be exported to WAV, FLAC, MP3 and OGG files. Engraved output can be exported to PDF, SVG, PNG and PostScript formats or it can be printed directly.

III. ALGORITHM AND IMPLEMENTATION

This section presents the various steps involved in converting the captured image of a score sheet into MusicXML file.

APPENDIX A

PROOF OF THE FIRST ZONKLAR EQUATION

Some text for the appendix.

ACKNOWLEDGMENT

The authors would like to thank...

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