

# Music Score Reader based on Morphological Image Processing

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## Motivation

A Music Score Reader on computer/mobile platform is a useful tool for many people. A soloist could have the computer play an accompaniment for rehearsal; a music editor could make corrections to an old edition using a music notation program [1]. In this project we are targeted to help people who don't know how to read music score to learn music. We scan music scores into the computer/mobile device, process the data and play out the music.

## Introduction

Figure 1 shows a sample image of the music score. Morphological Image Processing techniques were utilized to process the score images, e.g. image erosion, dilation, open and close.

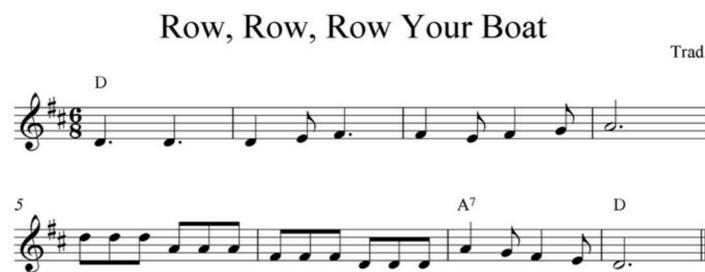


Figure 1. Sample Music Score

We first tilt the image such that the staff lines are horizontal, and identify their location. Then the staff lines are removed and we detect notes and calculate their pitch and duration. This step includes note head detection, hook/beam/augmentation dot detection, and pitch/duration calculation. Figure 2 shows the flow diagram of our approach.

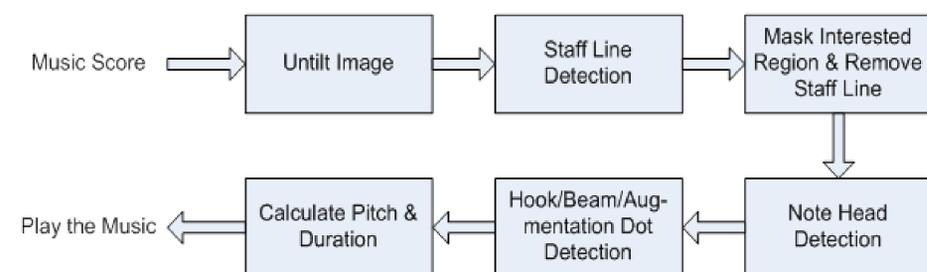


Figure 2. Flow Diagram for Music Score Reader

## Staff line Detection

After we tilt the image such that staff lines are horizontal, the staff lines can be easily detected by adding up the pixel values along every row. The rows where staff line locates will show a peak. Figure 3 show the result for the “Row, Row, Row you boat” image.

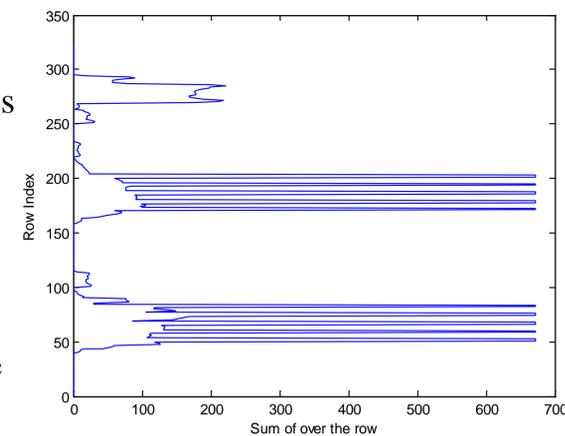


Figure 3. Staff line detection example

## Note Head Detection

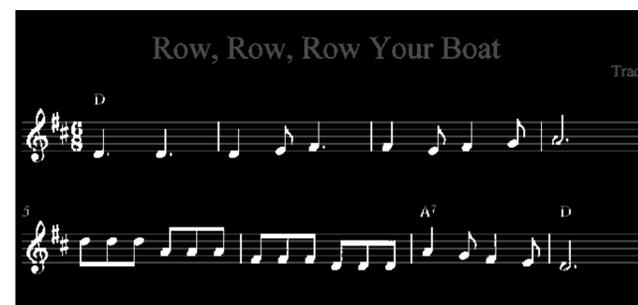


Figure 4. Staff line removed

with a horizontal structuring element to remove vertical lines, and a disk structuring element to remove small fragments. Figure 5 show the result for the first row. There's still many things other than note head remaining here, but those regions can be removed very effectively by checking the area, axis ratio and solidity. Figure 6 shows the final result for the note head

detection. After note heads are detected, we can calculate their pitches by comparing the head position and the staff line position.

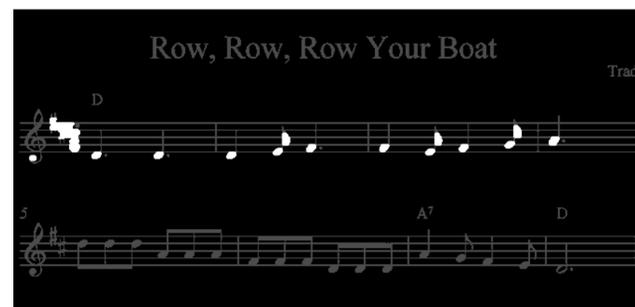


Figure 5. Result after opening for first row

## Hook/Beam/Augmentation Dot Detection

Detecting hooks, beams and augmentation dots is crucial for determining the duration of each pitch. For empty note head, we also have to

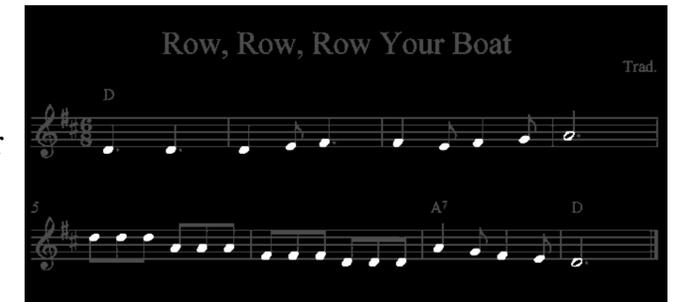


Figure 6. Result for Note Head Detection

determine whether it has a stick or not. For this step we only need to look at small regions around the note heads. Once the hooks/beams/augmentation dots were detected, we can use the following formulas to calculate the pitch durations:

$$D = 16$$

Otherwise:

$$D = 8 \times 0.5^{1-Empty} \times 0.5^{Num\ of\ Hooks/Beams} \times 1.5^{Aug\ Dot}$$

where “Empty” is a Boolean value that indicates if a head's empty. After this step we know both the pitch and duration for each note, we are ready to play out the music.

## Experiment

We applied our music score reader to several music scores with different level of difficulty. For simply scores, our algorithm can play them out without errors. Yet for difficult ones, the performance drops.

## Conclusion

In this project, we built a music score reader to help people who don't know how to read scores to learn music, and it works well with simple music scores. We took use of the morphological image processing techniques that we learnt from EE368 course this quarter, and gained a deeper understanding of them.

**Reference:** [1] Bainbridge, D., Bell, T. The Challenge of Optical Music Recognition. In Computers and the Humanities, 2001, Vol. 35, Number 2, pp. 95-121